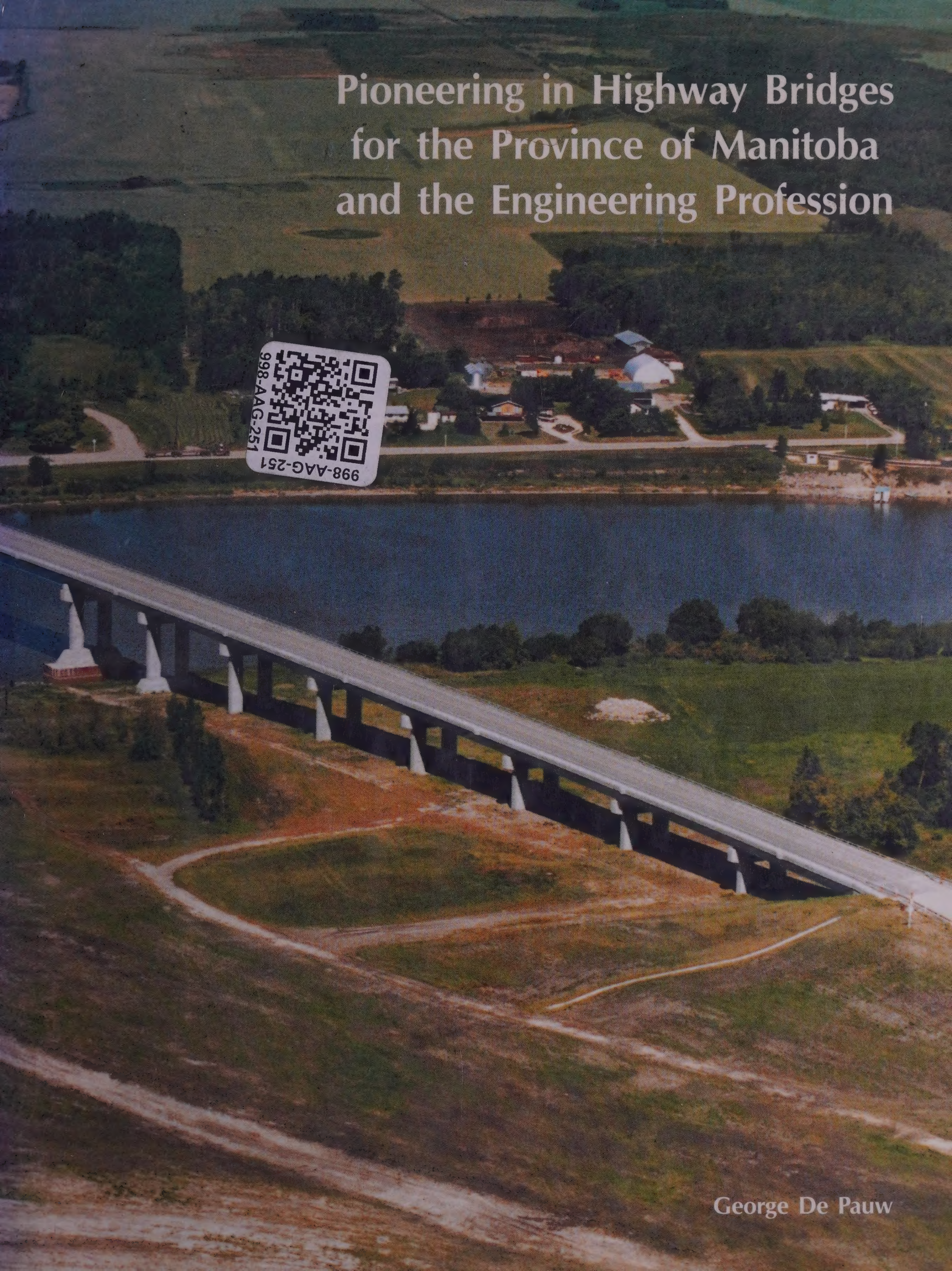
Pioneering in Highway Bridges for the Province of Manitoba and the Engineering Profession



George De Pauw

"Works, Technology and Ethics"

Pioneering in Highway Bridges for the Province of Manitoba and the Engineering Profession

At the beginning of the twentieth century civil engineers migrated to Manitoba to apply their knowledge and design skills to build the highways and bridges needed to open up the keystone Province, the gateway to the West. This is a story about some of these men who were prepared to devote their energies for the benefit of the people working to make a living in this new world.

Society has always shown an interest in bridges, probably because they are built over the natural waterways and streams which were used for travel and as a source of food. In this book there are over a hundred pictures of bridges built by the pioneers, many of which still exist in the roads and highways today. Those bridges which could be declared as "Heritage" structures have been identified. Other bridges featured in this publication were included to demonstrate how the technology of bridge design progressed through the years, and should be of interest not only to students of bridge design, but also to the general readership. The last chapter provides a pertinent and thought provoking look at the Profession's Code of Ethics as it relates to and influences the engineer's approach to his work and his duty to the public.

The bridge on the cover was designed by M. M. Dillon Ltd., Consulting Engineers. Its location over the Red River, north of Selkirk was not only politically controversial, but also required a special river pier design solution. Nevertheless, it is one of the most attractive bridges in the Province.

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George Alois De Pauw, P. Eng.

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Contents

"If the form and the content of the following pages are to be rightly understood, the reader must not misconceive the spirit in which they were written."

Teilhard de Chardin
Le Milleu Divin

The preface suggested by my son Mark in August, 1980, for a book proposed by him to be entitled: "Ethics, Technology and the Canadian Engineer."

This book is dedicated to the memory of Mark De Pauw, Master in Engineering (Civil), University of Manitoba, 1981; deceased October 17, 1986.

A "tree" bridge over the Cypress River located just upstream of its confluence with the Assiniboine River, east of the Spruce Forest Reserve north of Holland, Manitoba. Rev. Gerard De Ruyck is making his way across. A beaver dam can be seen immediately upstream of "Mother Nature's Bridge". Taken by Rev. Firmin Michiels, in the summer of 1991.

Acknowledgements

Without access to the files in the Bridge Division Office of the Department of Highways and Transportation of the Province of Manitoba, the compiling of the main body of this book would not have been possible. For the cooperation of Walter Saltzberg, P. Eng., the Director of the Bridges and Structures Division of the Dept. and his staff I am truly grateful. I am also indebted to the contractors who are named herein for their so willingly making copies of records and pictures available to me. The assistance received from the Provincial Archives, the Director of the Western Pictorial Index at the University of Winnipeg and the Managing Director of the Association of Professional Engineers of the Province of Manitoba was very much appreciated.

A special thanks is extended to Larry A. Buhr, P. Eng., Manager of M.M. Dillon Limited, Consulting Engineers and Planners, Winnipeg, and his staff for the drafting assistance given in preparing plates and charts; and to my son-in-law, Mr. R. Robert LeBlanc for designing, producing and desktop publishing this book.

Finally, to my wife Florence, my daughters and my sister, Mrs. R. Cornock, for the editorial assistance and encouragement so generously given, I am truly indebted.

George A. De Pauw

Financial assistance from the Manitoba Heritage Federation Inc. is gratefully acknowledged.

Foreword

Few works demand the combined knowledge of several civil engineering disciplines as much as the design and construction of Highway Bridges. The foundations are built in the bottom of rivers and creeks and in unstable banks. Therefore, a competent knowledge of soil mechanics and hydraulics is paramount. The structural components of the foundation have to withstand the forces of nature as well as variable man-made loads. The geotechnical performance of deep foundations must be understood. The design of superstructures, supported on the foundations, requires exacting knowledge of the theory of structures in order to analyze the stresses and strains produced by very heavy truck loads. The statistical frequency of these loads influences the fatigue strength of the structural components, requiring the design engineer to have intimate knowledge of basic bridge building materials such as wood, steel, concrete, paints and other protective coatings.

I am certain that all of you who will read the story of highway bridge building in the Province of Manitoba will marvel at the artistic ingenuity of the designers and come to appreciate the value of restoring and maintaining some of the heritage bridges identified in the book. Park areas which exist or could be developed around these bridges will improve the sites for the added enjoyment of the public.

M. A. LYONS - "First Of All An Engineer"

Introduction

At the beginning of the twentieth century Civil Engineers came together to help build the means of transportation so badly needed to open up the province of Manitoba. These roads provided pioneers with the much needed access to the railway stations and developing centres of commercial activity. This called for the replacement of ferries and "ford" crossings with bridges.

One of the first persons to become actively engaged in the design and building of these bridges was Manson Ainslie Lyons, P. Eng.[1], Bachelor Science in Civil Engineering (B.Sc.C.E.). He was assisted by several others who held the classification of Bridge Engineer.

The province's four bridge engineering positions were filled by Patrick O'Donnell Burke Gaffney, P. Eng., Bachelor in Engineering, Arts and Geology, 1905-1912; Arthur John Showell Taunton, P. Eng., B.Sc.C.E., University of Manitoba (U. of M.), 1908-1912; Bruce Alexander Johnston, P. Eng., B.Sc.C.E., U. of M., 1910-1915; and Eric Wallwyn McDonald James, P. Eng., M.Sc.C.E., University of Toronto, 1905-1910. In 1914, Mr. M. A. Lyons was appointed the chief engineer of the Good Roads Board, Province of Manitoba, having "had responsible charge of the design and construction of 80 wooden bridges, 35 steel bridges, and 350 concrete structures."[2]

In 1920 Mr. Lyons became the first president of The Association of Professional Engineers of the Province of Manitoba and served for two years, starting a professional trend for others to follow in the years to come.

The importance of legalizing the engineering activities must have been most evident to bridge engineers because of the high degree of technical design skills required of those engaged in this work. Several engineering disciplines are involved in the process of designing and the construction of highway bridges.

The following pages will illustrate photographically and technically how important this special field of engineering work was in developing a reliable network of roads and highways in this province.

It is interesting to note that many of the bridges built prior to 1920 are still in service in 1992, proof of the skills and dedication of the pioneering bridge design engineers given special mention in this book.

The importance of an ethical and highly competent approach in this field of engineering will be examined. A major portion of the book will highlight the innovative pioneering techniques which evolved over the century. The pictures and plates of the earliest and the most modern bridges built in the province, such as the bridge on the wrap-around, demonstrates how well the public has been served over the past eighty years.

1

The Achievements

The Pioneers in Engineering

The works of men that enhance the productivity of others and stand the test of time will always be regarded as a symbol of excellence. The building of bridges can be looked upon as such work.

The bridges still in existence, after providing a means of transportation across the beautiful rivers and streams of the Province of Manitoba for over fifty years, should be identified as heritage structures and preserved in a park-like setting for the enjoyment and use of future generations.

The pioneers involved in the design, supervision of construction and building of the many bridges existing in the highways and roads of this province deserve high recognition for their efforts. It is hoped that the following pages will provide such, while at the same time giving enjoyment to all interested readers.

Early illustrations shown in Plates 1, 2, 3, 4, 5, 6 and 7 exemplify the first efforts of the engineers in the Department of Public Works, using locally available materials in their designs for river crossings; and identify Dominion Bridge Co. Limited, of Winnipeg, Manitoba as the designer and fabricator of the first steel superstructures put in place as early as the year 1914.

The engineer who was instrumental in beginning the highly technical process of designing bridges for this province has been given prominence in these first pages.

Mr. Manson Ainslie Lyons, B.Sc.C.E., was born in Nova Scotia on November 14, 1879. He was educated in the province of his birth and attended the Massachusetts Institute of Technology, Boston, U.S.A., where he obtained a Degree in Civil Engineering, graduating in 1911. On June 4, 1912, he started employment as a levelman with the Good Roads Branch, Department of Public Works, Manitoba. Very soon thereafter he became Drainage Engineer and a Bridge Designer (see Plate No. 24, p. 176, Site No. 111).[3] On April 27, 1914 he was appointed the Chief Engineer at a starting salary of $2500.00 per annum. In November, 1936 he became the Assistant Deputy Minister and on March 1, 1941 was appointed to the position of Deputy Minister and at the same time held the post of Highway Commissioner. He retired in March, 1946.

M.A. LYONS

Although Mr. Lyons was head of the Department it is noted that his interest in bridge design was very keen and his approval signature is found on bridge plans as late as 1935 (see Plate No. 34, p. 218, Site No. 2264). Mr. Lyons was the first elected President of the Association of Professional Engineers of the Province of Manitoba (APEM) and served for two years, 1920 - 1921 (see Appendix 1, p. 242).

Mr. P. Burke-Gaffney, was appointed to the Bridge Engineer's position to replace Mr. Lyons on April 27, 1916. Some of his design work is identified on Plate No. 5, p. 120, and in the pictures on the following page. He is no longer listed with the bridge engineers after 1925. It is likely that he left the government position for more lucrative employment.

Mr. Patrick O'Donnell Burke-Gaffney, pictured below, was born January, 1888 at Kingstown, Dublin, Ireland. He obtained his University Education from the National University of Ireland with degrees in Economics & Literature, 1908; Mathematics & Geology, 1911; and Bachelor in Engineering in 1912. In April, 1913 he came to Canada and was employed with the C.P.R. as a rodman, instrumentman and Bridge Inspector before joining the bridge design office, Good Roads Branch, of the Province in June, 1915. He was registered with the APEM in the year of its founding, Nov. 1920. He was a member of Council for three two year terms, Registrar in 1924 & 1925, and President of the Association in 1939; evidence of his dedication to his chosen profession.

Mr. P. Burke-Gaffney cooperated with Mr. E. W. M. James on the redesign of the St. Norbert concrete arch, shown above, after a differential vertical displacement of the newly constructed footings had occurred. The concrete arch remained in place until 1962, having withstood major floods and modern truck loading, when it was replaced to improve the geometrics of the La Salle River crossing on Pembina Highway. The theoretical span between springing points of the arch was 99.58 ft (30.35 m). The above photo was taken by Patrick Burke-Gaffney on Oct. 27, 1920.

The reinforced concrete culvert, pictured below, was designed by Mr. P. Burke-Gaffney. The culvert is still in use today. The author in the photograph is pointing to the year it was built, 1919. There has not been any serious deterioration of the concrete over the 70 years it has been in place; although it has been subjected to heavy truck-axle overloading which it was not designed to support.

The concrete culvert is a two cell box 3 x 5 ft (0.91 x 1.52 m) and is 25.7 ft (7.83 m) long. It is located at the N.E. corner of Sec. 24-16-2 E., in the R. M. of Portage La Prairie (Site No. 508).

Harold Lloyd, P. Eng. who was Mr. Burke-Gaffney's assistant in 1916 is listed in February, 1925 with Messrs. E. W. M. James, E. S. Kent, B. A. Johnston and A. H. Taunton; as the bridge engineers working for the department at that time.

On Dec.22, 1928, four bridge engineers are listed in the civil service files as earning an annual salary of $3240.00; these men were Messrs. James, Lloyd, Taunton, and Johnston (see Appendix No. 2, pp. 246-248, for more information on engineering staff between 1916-1928).

Mr. Harold Lloyd was born in London, England on September 26, 1880. In researching his background, it must be concluded that he was a self educated man who worked in the day time and went to evening classes to enhance his skill and knowledge. His application for registration into the Association of Professional Engineers of Province of Manitoba indicates that he had no Degree or Diploma from any College or University. The educational qualifications in his application states: "Three years night school at Rochester Athenium & Mechanics Institute; Bridge Engineering, I.C. & Bridge Design-Evening Class-Columbia University". Nevertheless, he was deemed qualified to be a Registered Professional Engineer by the Council of the Association on Sept. 25, 1920. The records show that he immigrated to the new world in April, 1913 and must have joined the Good Roads Branch in Manitoba shortly thereafter. He was appointed one of the Bridge Engineers for the Department prior to year 1920.

Evidence of Mr. Lloyd's skill and competence is found in the performance of the bridges he helped design and check, which bridges are still in use in year 1992. (See Plates No's 7, 26, and 34, pages 124, 184 and 218 respectively, and the Dominion Bridge Co.'s drawing for Contract No. 1975, checked by H. L., dated 1925 for a bridge over the Assiniboine River, in the Municipality of Woodworth, N. of Sec. 16-10-25 W. (Site No. 7451, Plate No. 30, p. 206).

Edward Sherburne Kent, P. Eng., B.Sc.-C.E., was born at Truro, Nova Scotia on March 1, 1888. He attended the Nova Scotia Technical College and Dalhousie University, graduating in May, 1910. After serving overseas with the Royal Engineers during the war from 1916-1919 he joined the Good Roads Board, Highways Dept. to work in the bridge design office (see Plate No. 25, p. 178).

Bruce Alexander Johnston, P. Eng., was born at Melita, Manitoba on September 15, 1891. He was a graduate from the University of Manitoba in 1915 and on the strength of his summer experience was employed as the assistant bridge construction Engineer with the Canadian National Railway in early 1915, and later that year with the Manitoba Highways Department. However, before the year end he went overseas to participate in the war effort for three years, returning home to recuperate in the hospital in 1918-1919. In 1920 he once more joined the Good Roads Department of the Province as a bridge engineer. Some of his design work is identified in Plate No. 16(a), p. 148 and 16(b), p. 150 and Plate No. 26, pp. 184 & 186. Both bridges shown on Plate No. 16 are still in use in year 1992. His seal was imprinted on the

plans but unfortunately does not show on the reproduction. This is rather an ironic situation because Section 37, in the By-Laws attached to the Act to Incorporate "The Association of Professional Engineers of the Province of Manitoba" adopted in 1921 requires that "The seal must make an impression. A rubber or inking stamp will not be lawful".

Mr. B. A. Johnston became a registered professional engineer in 1920 along with all the other bridge engineers employed by the Highways Department and was the Association's president in 1947 and 1948, the last of the pioneering bridge engineers to hold that office in dedication to their profession.

Mr. Arthur John Showell Taunton was born at Solihull, Warwickshire, England on August 17, 1888. Although he received his early education in England, Mr. Taunton obtained his Degree from the University of Manitoba, graduating in 1912. After working for several years in the bridge office for the Canadian National Railway he became a District Bridge Engineer with the Provincial Highway Commission. On April 16, 1946, he joined the City of Winnipeg Engineering Department as Deputy City Engineer and Bridge Engineer. He retired on August 31, 1958 at the age of seventy. Mr. Taunton was President of APEM in 1924.

With the completion of the transcontinental railway it became necessary to build roads to make the railway stations more accessible to facilitate the distribution of the mail and goods, and to deliver the farm products to the world markets. For travel to be possible with the horse drawn carriages and the early motorized vehicles, bridges had to be built across the many rivers and creeks which flowed into and across the province from north-west, west, south and east towards the old lake "Agassiz Basin", now shrunk into the size of Lake Winnipeg.

The challenge was met by the men identified above, some of whom came from overseas and eastern Canada. They were joined by Manitoba born boys who had gone east to obtain a university education and then returned home to apply their engineering skills to serve the needs of the developing province. The exception was Mr. B. A. Johnston who obtained his Degree from the University of Manitoba.

Mr. Lyons set the example for those who followed both through his dedication to his work and by becoming the first elected President of the Association of Professional Engineers of the Province of Manitoba. What more appropriate tribute could be given than that published in the Winnipeg Tribune, May 3, 1946, recognizing him at the time of his retirement with the caption, "FIRST OF ALL AN ENGINEER". The durability of their works is evidence of the competence with which these Engineers carried out their duties.

ERIC WALLWYN McDONALD JAMES, P. ENG.
Above, centre, bottom row.

ANGUS A. LAUGHLIN, P. ENG.
Chief Bridge Engineer, 1956,
2nd Row, third from left.

Among the first of the pioneers listed previously and of those identified in the Bridge Office Staff-1950 photograph (facing page, upper), Eric Wallwyn McDonald James deserves to be called the "grandfather" of the bridge design office for the province. Shortly after graduating from the University of Toronto in 1910, he joined the Manitoba Department of Public Works as the Engineer in charge of road, drainage, bridge and water supply works until December, 1915. After then spending two years in Jamaica, he returned to take up a position as bridge engineer and became the Chief Bridge Engineer until his retirement in 1951. He was a native of this province being born at High Bluff, on August 12, 1885. He became a "Registered Professional Engineer" in 1920, along with the other colleagues working in the bridge design office for the Province of Manitoba at that time.

The author can still remember Mr. James, nick-named Jimmy, working away on his mechanical calculator, which could be heard from behind his office doors all over the design office. He was doing what he liked best, designing the bridge over the Red River at Emerson, on P.T.H. No. 75, leaving the administrative duties to his assistant, and successor, Tom Lamb, P. Eng.

Notably, the "St. James Bridge" over the Assiniboine River in the City of Winnipeg (Plate No. 34, p. 218), stands as a monument to "Jimmy James" the design engineer of considerable competence. In 1992, the foundations built in 1935 still support the reinforced superstructure which was re-designed to accommodate the much heavier trucks allowed on the city routes today. During his 36 years of dedicated public service, his approval signature appears on many hundreds of plans for bridges still remaining in the highway and road system in 1992.

The "bridge office staff" photograph taken in January, 1956 (facing page, lower) is evidence of how the staff increased between 1950 and 1957; now under Angus Laughlin, P. Eng., Chief Bridge Engineer until 1957 when the author was appointed to the position. Mr. Lamb and Mr. Laughlin were graduates from the University of Manitoba, with a Bachelor of Science Degree in Civil Engineering.

Builders of Bridges

A builder of bridges, Mr. Herbert Francis Howard (see bridge office staff pictures, page 6), born in 1901 near Macdonald, Manitoba, has to be recognized as one of the pioneers in this field of work. He started by helping his father, a farmer and contractor, build barns, bridges, schools, and other buildings for the surrounding Municipalities. The first bridge Mr. Howard helped build, known as the "Preston" bridge, was located west of Pilot Mound. This was followed by contracting bridge work for the provincial government, leading to his full time employment as the superintendent of bridge construction, with the Department of Highways under Mr. E. W. M. James, the provincial bridge engineer.

Mr. Bert Howard started working for the highways department in 1946 and retired from his bridge building tasks to become the Superintendent of the International Peace Garden in 1965. The improvements he brought about in the gardens were a work of love and are still enjoyed by the many visitors who come annually from the United States of America. At a retirement dinner in Mr. Howard's honour, Highways Minister Walter Weir described him as "the youngest old man of 65 I've ever seen". He is still enjoying his wood working and gardening hobbies at his home in Boissevain, Manitoba in year 1992, a living proof that hard work is the best medicine for longevity.

The conceiver of the very economical, durable, and versatile standard timber-bridge was Mr. M. P. Anderson, Technologist (see pictures, page 6), working under the direction of Mr. Angus Laughlin, assistant bridge engineer to Mr. E. W. M. James. The standard treated timber bridge had been developed to fill the demand for economical types of bridges using a material that would be readily available, and could be easily constructed by unskilled farm labourers, under knowledgeable supervision. The treated timber bridge was of a span range suitable for the crossing of the numerous small streams and creeks, typically found in south western Manitoba. The combined effort of Messrs. Anderson and Howard resulted in the construction of over three hundred treated timber bridges in the Provincial Highway and Road systems (see Plate No. 8, 9, 10, 11 and 12, pages 126-134 and pictures on page 92 and 93).

The establishment of revolving stockpiles of standard timber components, including steel and treated timber piling and associated bridge iron, located at Brandon, Dauphin and Beausejour resulted in the economical and immediate availability of these materials. Mr. Victor Reynolds, C.E.T. (1956 picture, facing page), was the first individual to hold the position of "Bridge Materials Technologist". Mr. Reynolds was born in Winnipeg Beach to Ukrainian parents, Hnat and Lena Zelenitsky, who immigrated to Canada in 1895 and 1911 respectively. He received his education at Winnipeg Beach where he started working for the Highways Department in 1956 as a member of a survey party. He was later transferred to the Winnipeg office where he worked as an engineering aid and accounting clerk prior to his joining the Bridge Division.

Mr. Reynolds deserves recognition for the dedication with which he served for some forty-two years, thirty-two of which were with the Bridge Division. He meticulously set up an accounting system by which records were kept of the revolving stockpile materials. The system was easily understood and Vick was able to provide engineers with day to day information on materials on order, on hand and those requested for delivery. Very seldom was an error made and the annual audit always verified his records. He held a diploma in grading lumber from the Manitoba Forest Products Association. His knowledge of various grading rules for west coast timber products and specifications for preservative treatment and the specification for the supply of bridge bearings, steel products, cement and paint ensured that only materials meeting these specifications were incorporated in the bridges.

Mr. Reynolds held a "Blasters Certificate", an art he learned from age sixteen, as well as a "Certificate for Handling and Transporting Dangerous Materials". In his capacity as Materials Technologist, he was instrumental in developing a safe practice in the handling and storage of high explosives for the entire Highways Department. He can tell, and personally relate to, some "hair-raising" tales about how our bridge crews were asked to set off dynamite charges beneath ice floes using helicopters to break up ice jams, in our usually unsuccessful attempts to prevent damage to bridges and to reduce flooding. Fortunately, no serious accident ever occurred, thanks to Mr. Reynolds' insistence that safe practices be adopted.

Mr. Reynolds retired from government services on April 8, 1988.

VICTOR REYNOLDS

I would be remiss if I did not mention Mr. Henry Huff, a senior carpenter and foreman on the bridge maintenance crew from 1948 to 1963. He retired at the age of 70. His sons Albert George and William followed in his footsteps and rose from labourers to become superintendents of the bridge maintenance and construction crews. George served from 1951 until his untimely death in 1971. Bill was promoted to replace his brother and served in that capacity until his retirement in 1983. The public was well served by the Huff boys and their father.

The bridge in the picture above (taken in 1985) is located over the Fisher River, E. of the N.E. ¼ Sec. 14-28-1 W. in the Interlake Unorganized district, Site No. 2474. Designed by Mr. James in 1944, this treated timber bridge has been subjected to heavy overloads in recent years, yet performed well until a vehicle hit the trusses, damaging some of the members. Even then, this type of truss design prevented collapse of the span. Later on, repairs were made and the bridge still remains in service today.

The main truss span is 46 ft (14.02 m) long and has an overall length of 147 ft (45 m), (see Plate No. 17, pp. 152-154). An interesting report regarding the "Treatment and Inspection of Creosoted Douglas Fir Lumber" for this bridge is included in Appendix 3, p. 249. There is no doubt that the timber treated with hot creosote oil under pressure is the most effective preservative known. Many of the timber bridges built using this type of preservative have remained in service for more than fifty years and are being replaced only because they have become functionally obsolete. This type of preservative was also used on timber piling.

The picture below shows a rig used for driving the treated timber piles, also treated with creosote oil. The owner of the "A" frame pile driver was probably Mr. Dave Trottier, a contractor who built many of the treated timber bridges still existing in the province's roads today. Mr. Trottier was the president of La Salle Construction Co. and through his ingenuity managed to regularly submit the lowest bid price for the construction of these timber bridges.

The pictures (above and below) are of the "Medika" bridge, so named because of its location in the vicinity of the early Ukranian settlement along the banks of the Whitemouth River. It is on P.R. No. 507, N. of Sec. 10-9-12 E. in the L.G.D. of Reynolds, (Site No. 2517).

In the construction picture (above) two bridge engineers, Mr. Angus Laughlin and Mr. Gordon Gillespie are making inspection of the work under way. Mr. Gillespie was the assistant bridge engineer to Mr. Laughlin in 1955 and subsequently became the President of Pile Foundations (formerly Harris Construction Co.) whose company built several bridges all over this province. The bridge was designed by Mr. T. Lamb, who became the Chief Bridge Engineer in the late 1940's. It was designed for a 15 ton (MS 133) and a 12 kip (53.4 kN) wheel load. The "Queen Ann's" timber scissor trusses were each 36 ft (10.97 m) long, (Plate No. 18, p. 156). A new bridge has been built on a new alignment, and therefore this unusual bridge type could be preserved as a "Heritage" structure.

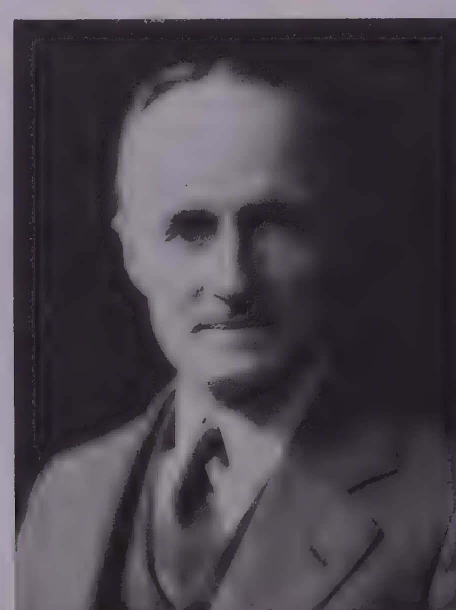
Among the "Builders of Bridges" the construction company of Macaw and Macdonald Ltd. was one of the earliest and most prominent.

On February 16, 1989, the author visited Ken Macaw, P. Eng., President of M. & M. Construction Co. Ltd., to ask him for his assistance in obtaining the history of the company's bridge building record. During the visit the following success story unfolded.

His father, Arthur Macaw, came to Canada in 1904 and got started in the construction business building homes and offices. Later on he formed a partnership with Mr. Robert Johnstone Macdonald and started contracting for the construction of bridges. Arthur Macaw was a self-made individual. An orphan very early in life, he immigrated to Canada from Ireland and became a successful business man. In 1908 the partnership of Macaw and Macdonald was formed and they successfully built many piers in river beds across this province. Their sons picked up the challenge and continued the important work of bridge building.

Mr. Ken Macaw was born and educated in Manitoba. He received a B.S.C.E. degree in 1949 from the University of Manitoba, having been elected Senior Stick in his final year. In 1954 the company became a limited Co. and Ken became the president after his father's death in 1958. His son, W. Arthur Macaw also joined the firm after graduation from the U. of M. in Civil Engineering and is well on his way towards carrying on with the family tradition.

A story has it that Mr. Arthur Macaw and the residents of MacGregor, Manitoba, were entertained by Mr. James during one of the field trips to inspect the construction activities in the area. You see, the chief bridge engineer enjoyed playing the bag-pipes.



ARTHUR MACAW

The driving force during the early beginnings of the company was one of its founders, Mr. R. J. MacDonald. He had started in the construction of bridges and buildings in partnership with his brother before joining forces with Mr. A. Macaw.

Mr. MacDonald was born in Newcastle, New Brunswick and died tragically in 1949 while rowing across the Saskatchewan River with his son Alistair. At that time their company was building the "Saskatchewan Landing" bridge. After high school, Alistair attended Wesley College and the Success Business College before entering full time into the construction business. His main responsibilities were the arranging for and the maintenance of the equipment, a most important part of running a successful contracting operation.

ROBERT J. MACDONALD

Some of the bridges built by MACAW and MACDONALD LTD. are listed below:

1. *The St. James Bridge located on Route 90 in the City of Winnipeg.*
2. *The Provencher Bridge in St. Boniface, Man.*
3. *The bridge over the Souris River on P.T.H. No. 10 south of Brandon, Manitoba.*
4. *The bridge over the Red River on P. R. No. 217 in the village of St. Jean, Manitoba.*
5. *The bridge over the Red River in Selkirk, Manitoba.*
6. *The reinforced concrete frame over Omand's Creek on Portage Ave. in the City of Winnipeg.*

Pictures and descriptions of these bridges can be found on the following pages.

· St. James · Bridge ~ Assiniboine · River ·
· Macaw · & · Macdonald ·
· 1936 ·
M. A. LYONS · Chief · Engineer ·
· E. W. M. JAMES · Designing · Engineer

The bridge pictured above is located on Route 90 in the City of Winnipeg. The superstructure of this bridge was modified in recent years, still supported by original foundations and incorporated into a major traffic interchange. The bridge is 624.67 ft (190.4 m) long. Note that this bridge was designed by E. W. James, and that the plans were approved by M. A. Lyons. (See Plate No. 34, p. 218, Plan No. 2264 and Appendix 4, p. 250.)

The picture on the right provides a beautiful view of the Souris River Valley, looking east towards the three span reinforced concrete arch bridge, located on the old alignment of P.T.H. No. 10, north of Minto, in the N.W. ¼ Sec. 21-6-19 W., R. M. of Whitewater, Site No. 1580. This bridge was designed by B. A. Johnston and built by Macaw and Macdonald Ltd. in 1928. The picture was taken by Steve Sapinski, P. Eng. on Aug. 23, 1976, after the waters of the 1976 flood had receded. The flood water at its peak stage overtopped the south approach road for the first time since the construction of the concrete arches.

·Portage ·Avenue· Subway·
·Macaw·&·Macdonald
·1936·

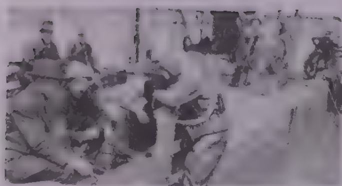
The concrete rigid frame (above) is located over 0mand's Creek on Portage Avenue in the City of Winnipeg. It has a clear span of 40 ft (12.19 m) with straight back wing walls, and provides a clear roadway width for vehicular traffic of 76 ft (23.16 m) with two 8 ft (2.44 m) sidewalks. The unique and aesthetically pleasing concrete structure exists on the busiest east-west route in the city. This creek crossing will probably remain in service for many more years; a tribute to the designers and builders of a half century ago.

The picture (right) of the bridge over the Red River at St. Jean, Manitoba was taken in 1962 showing the contractor, Macaw and MacDonald Ltd., in the process of constructing a permanent strut below the riverbed to prevent the main piers from moving together. The same contractor built the substructure for this bridge in 1945-46, (Site No. 2465).


ROLLING LIFT BRIDGE
PATENTED.
DESIGNED BY
THE SCHERZER ROLLING LIFT BRIDGE COMPANY
CHICAGO.
BUILT BY
DOMINION BRIDGE COMPANY LIMITED
WINNIPEG A. D. 1918

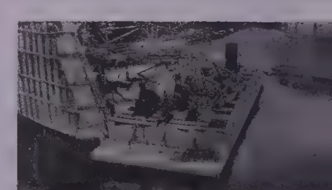
The substructure for the bridge located over the Red River on Provencher Avenue in the City of Winnipeg was built in 1913 by Macaw and Macdonald Ltd. The pictorial collage (overleaf, left) shows the foundation under construction. The top picture, taken circa 1916, after the superstructure had been erected, shows the Cathedral in the City of St. Boniface in the background. The picture (facing page, lower) which was taken in 1989 shows the skyline of the City of Winnipeg. Note the old timber piling sticking out of the river bed above the ice. It is from an older timber bridge between the two cities; probably built using timber pile trestles, which were subsequently destroyed by ice soon after its construction. The picture (facing page, upper) shows the overhead steel frame connected to the lift mechanism to allow for the opening of the centre span for the passage of boats up river. The elaborate system cost some ten thousand dollars and caused the low bid by Manitoba Bridge and Iron Works Co. to be rejected in favour of the proposal by Dominion Bridge Co. to construct counterweights underneath the deck by adopting the "Scherzer Rolling Lift Bridge" patented system. Dominion Bridge Company's tender for the steel superstructure was $264,707.10. This shows how much importance was placed on the provision for navigation on the river in 1918, a perceived need still influencing the design of new bridges in 1989. Yet, as far as the author could determine, the Provencher Bridge was never opened to allow for the passage of boats and by the later attachment of pipe lines to accommodate utilities, the ability to open the bridge was permanently curtailed.

The Provencher bridge is 920.1 ft (280.45 m) long, with a maximum span of 167.5 ft (51.1 m) crossing at a skew angle of 30 degrees. It is a continuous steel girder and concrete structure. The steel stringer and concrete floor system was rebuilt in 1964 to accommodate HS 20 (MS 180) truck loading. (See Plate No. 36, p. 226.)







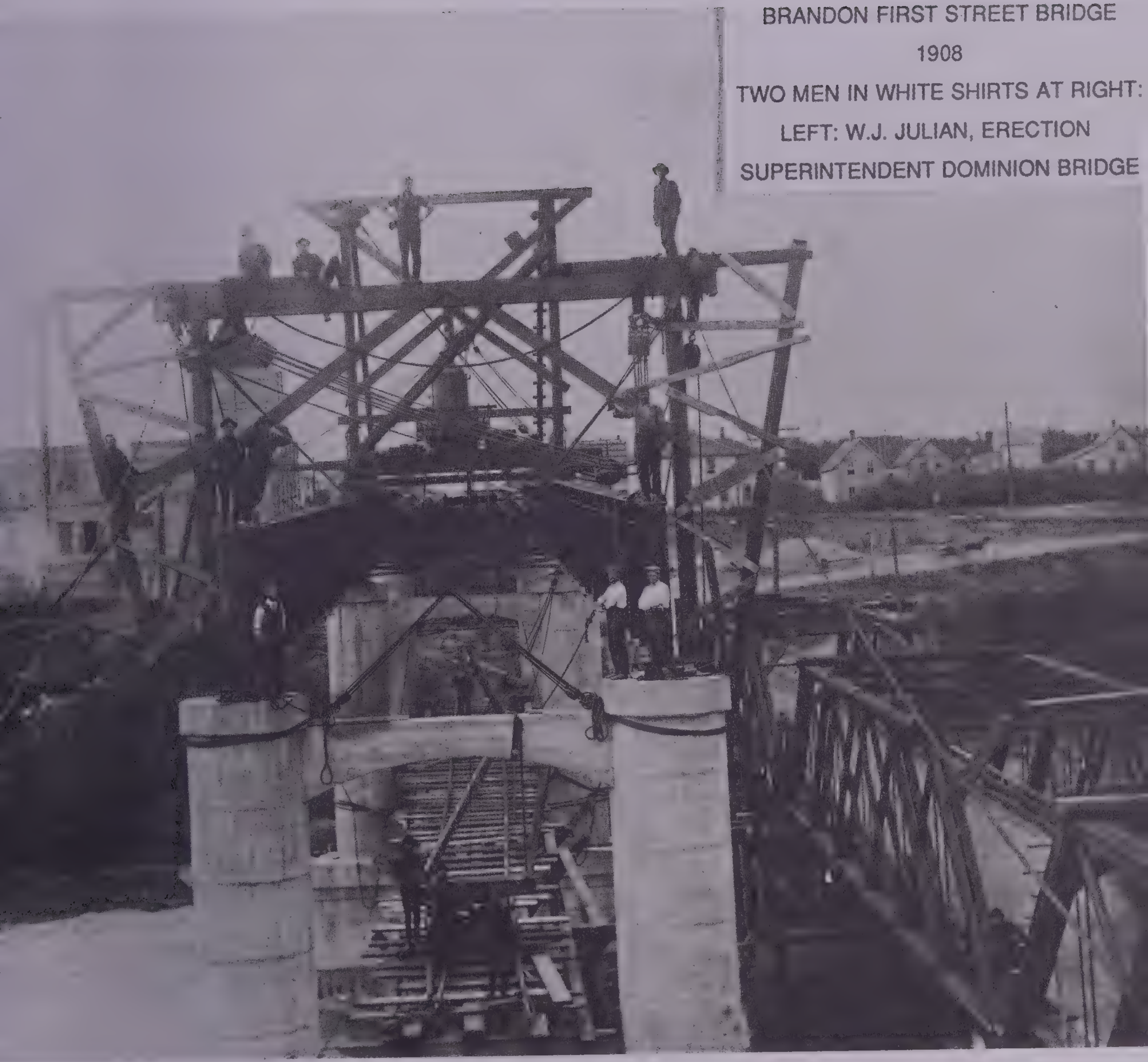


· PROVENCHER · BRIDGE ·
· Over · Red · River ·
· 1913 ·

The pictures (below and overleaf) are of the bridge over the Red River at Selkirk, Manitoba located on Provincial Road No. 204. It was constructed by Dominion Br. Co. Ltd. and Macaw and Macdonald Ltd. in 1935-36. It is an excellent example of their pioneering skills. The bridge incorporates a unique counterbalanced lift-span to provide 70 ft (21.3 m) clearance above water level to permit the passage of sail boats.

Note the tourist boat passing beneath the bridge in the picture taken during the summer of 1976. The earlier pictures show the foundations under construction and the steel superstructure being erected. The bridge is still in use in 1992. It is 762.3 ft (232.35 m) long and provides a vehicular roadway width of 20 ft (6.10 m), with sidewalk on the downstream side. For full details of the lift-span see Appendix 5, p. 251.

A "Heritage" candidate, the superstructure of the bridge was strengthened and remodelled in 1992. This will allow the passage of trucks with a heavier concentration of axle loads and thereby will enable it to remain in service for local passenger vehicles and light farm trucks for several more years (see Plate No. 31, pp. 208-210, Site No. 352.). A. J. Taunton, P. Eng., left, one of the pioneers identified earlier, was the Resident Engineer responsible for the field construction supervision of this bridge.



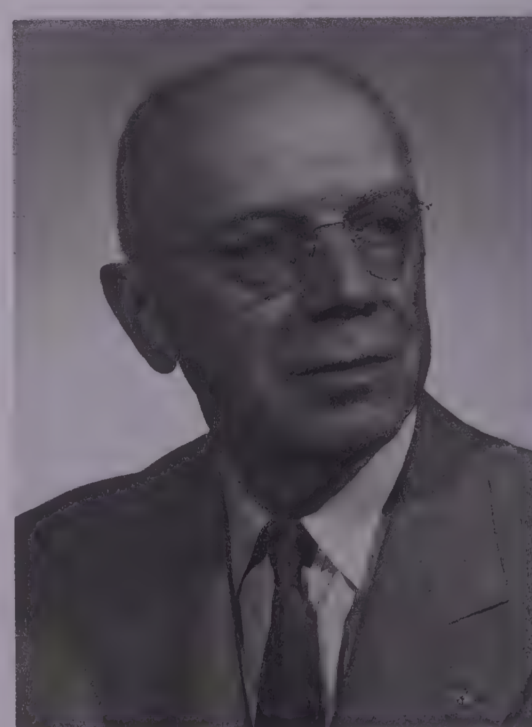
BRANDON FIRST STREET BRIDGE
1908
TWO MEN IN WHITE SHIRTS AT RIGHT:
LEFT: W.J. JULIAN, ERECTION
SUPERINTENDENT DOMINION BRIDGE

For the longer span lengths required to cross some of the major rivers, the use of steel girders and steel trusses for the construction of the superstructures was a more economical solution when compared with cast-in-place concrete. The picture (previous page) of the new bridge under construction over the Assiniboine River is an early example of a rivetted steel girder type being used to replace its forerunner, a wooden truss with steel tension rods. The "two men in white shirts at the right" were probably the engineers in charge of construction.

A designer and builder of steel structures, Mr. Harry Manning White, P. Eng. has to be recognized as one of the bridge building pioneers. He was born near Chatham, Ontario, on June 2, 1888. He graduated in Mechanical Engineering from the Faculty of Applied Science of the University of Toronto in 1910. After graduation he joined the design office of the Dominion Bridge Co. Ltd. at Lachine, Quebec. In 1919 he was transferred west to Winnipeg at a time when Dominion Bridge Co.'s Branch Plant was just fourteen years old.

Coinciding with Mr. White's transfer to the west, the Winnipeg Branch began to operate practically as a complete unit handling the engineering design, plant fabrication and field erection of steel bridge superstructures. Mr. White became the Chief Engineer of the Western Division in 1930, a position he held until his retirement in 1950. He served as President of the Association of Professional Engineers of the Province of Manitoba in 1934.

Dominion Bridge Company Ltd. came to Winnipeg at the turn of the century; built a plant (facing page) and successfully competed for work to satisfy the demand for steel structures. One of the monuments of the company's earliest efforts is the bridge over the Assiniboine River on a municipal road near Virden Man.; built circa 1925 and still in use today. (See Plate No. 30, p. 206 and pictures on pp. 26 & 27). The company was most likely involved in building bridges for the City and the Railway Companies, but coverage is beyond the scope of this book.



HARRY M. WHITE

DOMINION BRIDGE COMPANY LIMITED
1913

From 1935 through to 1950, H. M. White, P. Eng., Chief Engineer for Dominion Bridge Co. Ltd., supervised the fabrication and erection of many steel truss bridges which were built across the major rivers, such as the Assiniboine and Red Rivers. The trusses placed across the Red River east of Letellier, and near St. Jean and Morris are notable examples. The large trusses at Morris were replaced with the more modern continuous welded steel-concrete girder arrangements, allowing for unlimited overhead clearances and yet built so that the underside of the girder would be clear of the recorded high water flood levels. Consequently, the centre of the top of the roadway surface of this style of bridge is the highest point in the landscape when looking across the flat land of the Red River valley, which is the bottom of Lake Agassiz, formed during the Ice Age and often mistakenly referred to as the Prairie.

The steel trusses at St. Jean are still in place, but not without the annual spring run-off problems when ice floes pile into the bottom chord members, followed by the related foundation shifts after the water levels drop and draw-down effects cause the bank slippage. A solid concrete strut had to be built below the bottom of the river bed to prevent the two main pier footings from moving closer together (see Picture on p. 15). The site on the Red River, east of Letellier on Provincial Road 201, has the deepest bed of clays known in the Province, and the bearings of this bridge have been re-positioned and modified many times to accommodate the foundation movements by as much as five feet (1.92 m) or more, (see picture on p. 82). Creep movements of the banks along the Red River have caused a major problem for bridge engineers, but the discussion of solutions are too complicated to explore in this book. However, some of the causes and solutions are briefly identified in Chapter 2.

By 1967, the old steel trusses over the Red River at Morris, Manitoba had to be replaced because foundation movements had created a potentially dangerous situation. The rocker bearings were about to tilt off the top of the piers. Nelson River Construction Co. Ltd. was awarded the contract to remove these large trusses- not a simple task; the bridge superstructure having to be supported on false-work before load-carrying members could be removed in a reverse sequence to that used in the erection process, (pictures on facing page). F. M. Fowler, P. Eng., the President of Nelson River Construction Company was also the successful bidder to construct the substructure for the bridge over the Red River north of Selkirk, (see Plate No. 37, pp. 228-232, Site No. 1662).

Mr. Fowler was the President of APEM in 1968. His father, Mr. F. S. Fowler is listed among the Charter members of APEM in 1920, (see Appendix No. 1).

Many thousands more bridges have been built across the rivers, creeks and streams, however, they are too numerous to feature in this book; but they are in place, allowing traffic to safely travel across; thanks to the many engineering design specialists working for the Public Agencies, Consulting Firms and Contractors.

The history of City and Railway bridges is beyond the scope of this book, but I am sure such a written work would be of interest to many.

Some of the pictures and plans were selected to illustrate the many varied styles of bridges which were conceived by the designers in the early years, all of which were well built by skilled craftsmen using quality materials. It is hoped that the reader will enjoy the pictures and associated comments which have been included as "Monuments to Bridge Designers" in the following pages.

Erection of the steel superstructure over the Assiniboine River, near Virden, in the R.M. of Woodworth, (Site No. 7451).

Located in the beautiful Assiniboine River valley, N. Sec. 16-10-25 W. in the R. M. of Woodworth, east of Virden, this impressive steel truss, built in 1926, still serves the public in the year of 1992; adequately supporting heavy modern farm equipment and transport trucks exceeding 72,000 lbs. (320 kN) gross weight.

Designed to safely allow the passage of an 18 ton (160 kN) tractor or 80 lb/ft^2 (3.83 kPa) live load, the crossing consists of a single 170 ft (51.82 m) truss span, providing an 18 ft (5.49 m) wide roadway and 30 ft (9.14 m) high, it rises above the tree tops growing along the banks of the river. It is a truly historic bridge worthy of preservation as a "Heritage" structure. The "blue print" of the Department of Highway's standard "Parker" truss, this bridge epitomizes the design and the building of bridges in the early days of the formation of our province. Located in the heartland of the farming district in western Manitoba, it is one of the longest clear spans across the Assiniboine River. (See Plate No. 30, p. 206, for details).

The picture above was taken in July, 1988 and the pictures on the facing page show Dominion Bridge Co. in the process of erecting the bridge in 1926. These pictures can be compared with the process of dismantling a similar truss on page 25.

The picture above shows a half-through "Warren" steel truss. It is now located on the Agricultural Museum grounds at Austin, Manitoba. This bridge was originally built over the Pembina River on the "Commission Trail", south of La Riviere, now identified as Provincial Road No. 423. The trail was used by the immigrants coming from the south and east to settle in western Manitoba. The bridge still serves the public well as a creek crossing for those visiting the museum. The steel superstructure is the only "pioneer" bridge preserved this way in the Province. The structure is unique in that it is fabricated in such a way as to make it act in a truly pin-connected fashion. The picture (below) illustrates a typical connection. Unfortunately, no detailed drawings of the bridge exist and it has therefore not been possible to establish its live load capacity, but it was probably designed to accommodate an 18 ton (160 kN) steam engine and/or 80 lb/ft^2 (3.83 kPa) live load.

Monuments to Bridge Designers

M. A. Lyons' Bridge over the Whitemud River
Picture by Father F. Michiels, taken July, 1991; also see p. 47

The bridge, shown above, over the Assiniboine River at Shellmouth, Manitoba can be identified as the Federal Government's contribution to opening up the North-West. Built in 1906 under the jurisdiction of Mr. Eugene D. Lafleur, Chief Engineer in Ottawa, it has carried much traffic during its 84 year existence.

This is an example of a well weathered steel structure. (See pictures above and below which were taken in March, 1984.) The trusses did not exhibit any serious corrosion after many years of exposure, while receiving little or no maintenance. Unfortunately, The bridge was recently removed and therefore cannot be designated as a "heritage" structure. It was located N. of the N.E. ¼ Sec. 30-22-29 W. in the R.M. of Shellmouth.

It's overall length was 360 ft (109.73 m) made up of a central "scissor" steel truss 160 ft (48.77 m) and two 80 ft (24.38 m) standard half-through Warren truss approach spans. It provided a roadway width of 18 ft (5.49 m) and was probably designed to support an 18 ton (160 kN) steam engine or 80 lb/ft^2, (3.83 kPa) uniform live load. See plate No. 32(a) and (b), pp. 212 & 214 for more details.

This bridge over the Swan River on Provincial Road (P.R.) No. 268 near Lenswood, N. of Sec. 34-38-25 W., R. M. of Minitonas, is 17 ft (5.18 m) wide, (shown in the end review), and 281 ft (85.65 m) long, (Site No. 2528).

The lower picture shows the piers with the raised pedestals to provide additional clearances as was recommended by A. H. Corbett, P. Eng. It is interesting to note that Mr. Corbett was one of the pioneers registered with the Association in 1920. He designed the bridge while working with the Reclamation Branch of the Department of Public Works in 1935. Even in these early years the plan specified that "alkali resisting cement be used".

In 1948 Mr. Corbett, now the District Engineer, wrote that "the easterly span was pushed off the abutments by the abnormal run of ice, and carried about a mile downstream and is now lodged along the west bank; at this point. I found it has been badly warped and twisted and I do not think it can be replaced without rebuilding. The westerly span, I think, with some repairs to the floor system, would still function." and "In the event of replacement I believe it would be advisable to raise the piers and abutments three to four feet higher". The 1974 spring floods, carrying thick ice floes, removed the trusses off the foundations at the Swan River crossing on P.R. No. 366, (built in 1920) but they passed beneath the "Lens Bridge" without causing any damage to the raised superstructure at this site.

The original bridge consisted of two 108 ft (32.92 m) Pony Trusses, designed for 80 lb/ft (3.82 kPa) and a single 15 ton (133 kN) truck. Approach spans were added in 1948 and the timber deck system on the trusses were repaired. In 1978 the approach spans were replaced with salvaged steel stringers using 2 in x 62 in decking and the old bridge was restored by cleaning, painting and repairing as needed. These improvements permitted the truck loading to be increased to vehicles not exceeding 36 tons (320 kN). This bridge should be identified as a "Heritage" structure. See Plate No. 29, p. 204 for details.

One of the most spectacular escarpments in the Province, forming a large meander above the Town of Wawanesa, contains a weathered steel truss span over the Souris River. The steel truss has an overall length of 150 ft (45.72 m) and supports a roadway width of 16 ft (4.88 m). The pictures were taken Aug. 19, 1992, Site No. 727, P.R. 344. The bridge was built in 1907 and still provides safe passage for local traffic over the river. The steel truss shows no sign of ever having received a protective coat of paint, yet no significant loss of steel cross-section has occurred (see picture of pin connection, right).

Mr. Archie McGillivary was the engineer responsible for its construction. He was the commissioner of Good Roads for the province when Mr. M.A. Lyons took on the job of bridge engineer in 1914. The bridge can be and should be declared a "Heritage" structure and preserved as is, in recognition of our pioneers, in this case A. McGillivary, P. Eng.

The bridge below is 150 ft (45.72 m) long and provides a clear roadway width of 17.8 ft (5.425 m). It is located on Prov. Road No. 408 over the Whitemouth River in Sec. 15-12-11 E., R.M. of Whitemouth, Site No. 1470. This bridge could be preserved as a "Heritage" structure.
The two span, one half through truss superstructure was designed by Mr. Harold Lloyd and checked by Mr. A. J. Taunton (see Std. e-43, and Plate No. 7, p. 124 for details of the "Warren" steel trusses). Note that the design live load was an H15 (MS 135) truck and that in 1982 Mr. George Schultz rated the structure as adequate to safely allow the passage of a vehicle not exceeding 33 ton (293.6 kN) gross weight.

The substructure was designed by Mr. A. J. Taunton in 1925; and the abutments for the bridge were supported on precast steel reinforced concrete piling. As can be seen from the picture above, the piling is still in good condition after 65 years in an exposed environment. (See Plates No. 6 , p. 122 and 23(a) and (b), pp. 172 & 174 for more details). The supporting capacity of these piles under modern axle truck loading deserves investigation, recognizing that it was not until 1957 that major use of driven precast concrete piles was again implemented, after test loading demonstrated their strength and usefulness in end bearing capacity. (See Chapter 2, page 84.)

George Schultz, P. Eng. was the Senior Design Engineer for the bridge Division of the Department of Highways and Transportation from 1966 till his death in 1985. He was a very competent design engineer and his dedication to his work contributed greatly towards the development of the prestressed precast concrete bridge superstructures, many of which are now in service all over the Province.

The pictures on the right and the project description on the following page were prepared by Mr. George Schultz, responsible for pioneering the design of the modern precast prestressed concrete standard bridge shown; an economical substitute for the earlier timber standards. The special design feature is the locking washer system used to make adjacent parallel units work together to distribute the wheel loads. (See Plate No. 14, p. 144 for details).

GEORGE SCHULTZ

PROJECT DESCRIPTION

Due to the increased costs of sawn timber beams supplied from the western U.S.A. and utilized in the previous standard bridges on Provincial Roads, it was decided to develop a locally manufactured beam to replace the sawn timber beam. The basic materials going into the manufacture of this product such as cement, aggregate and reinforcing steel are produced locally (except for the prestressing strands).

A precast, prestressed concrete channel beam type bridge was designed for 2 span lengths; 8 metres and 12 metres. Three roadway widths were also accommodated, namely 8.4 metres, 9.6 metres and 10.8 metres.

The development of the new standard concrete beams accomplishes the following:

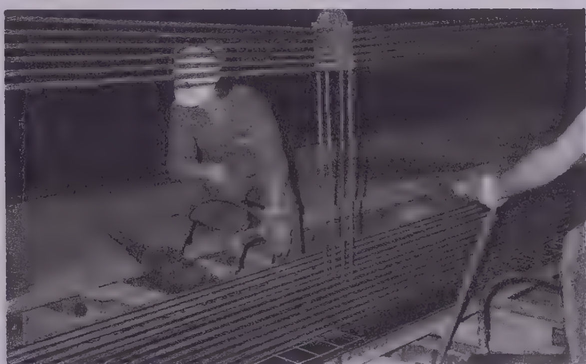
1. provides a low cost bridge while still being able to handle modern truck traffic. An average cost of superstructure of the bridge is $ 160 per square metre.
2. provides a bridge which can be constructed on site quickly, even in the severe Manitoba climate because no concrete is cast on the site which would require elaborate hoarding and heating.
3. provides the local precast manufacturers with a new product line. Up until November 1, 1981 the Bridge Division has tendered 321 - 12 metre beams and 82 - 8 metre beams. The total cost of these beams to date is approximately $ 630,000.
4. provides a more fire resistant bridge.
5. provides an alternative type of construction for other road authorities such as municipalities.
6. provides the Province with durable bridges which are noted for their ease of construction, pleasing aesthetics and low maintenance and construction cost.

The Prestressed, Precast Concrete Bridges

There are two basic types of prestressed concrete; the PRE-tensioned and POST-tensioned. The most common type of prestressing used for the manufacturing of beams and girders is the pre-tensioning system. The steel is stressed before the concrete is placed in the forms. Stranded cable is stressed between two buttresses anchored to a stressing bed. The pictures (facing page) show a set of high strength steel strands being tensioned prior to the forming and the placing of the concrete. The lower picture shows a buttress and the anchorages holding the tensioned steel strands in place for the manufacturing of concrete piling. In the picture (right) the draped strands are being jacked down into their final position after tensioning. Powerful hydraulic jacks are used to tension and induce stress in the cables. (Pictures are courtesy Supercrete Ltd.) The pretension method described above was the main method used in developing the Highway Department's precast concrete bridge standards illustrated in this book, although some of the first I-girder sections used both systems. Post-tensioned concrete is made by forming holes where the steel is to be placed. After the concrete has hardened, the steel is inserted and stressed against the ends of the beam. The remaining space in the hole is usually grouted to protect the steel.

In 1956, T. O. Lazarides, Dr.-Ing., U.I.Lv. came to Manitoba and encouraged the highway authorities to embrace the Prestressed Concrete System for use in design and construction of highway bridges. This resulted in the construction of the first pre-tensioned and partially post-tensioned prestressed precast concrete I-girder bridge. The bridge was built over the Brokenhead River in P.T.H. 4 E. (See Appendix 6, p. 252 and picture No.3, p. 95.)

In 1957, T.O. Lazarides, Damas, and Associates, Consulting Engineers were retained to design and prepare a complete detailed set of drawings of standard prestressed concrete beams and girders for use in the construction of bridges; many of which are identified and pictured in the following pages.



The picture (facing page) is a view of the partial excavation of the Red River Floodway Channel and a truck delivering a 91.25 ft (27.8 m) precast prestressed concrete I-girder to the site. It was the first and the longest bridge built across the Red River Floodway, the work having started in 1963.

The bridge is 807 ft (246.0 m) long consisting of seven 91.25 ft (27.8 m) precast prestressed concrete girders, a first for Manitoba. The tenders for its construction called for alternative bids between a welded steel girder and the newly developed design standard in precast concrete. The successful low bid in concrete set the pattern for the rest of the bridges across the floodway. A listing of the tender prices received can be found in Appendix 8, p. 256). The cost of the steel alternative exceeded the cost of supplying the prestressed concrete girder in the selected span lengths for the floodway cross-section.

However, the use of the steel piling proved economical because of the higher load used, based on the test load for piles driven to refusal to the top of the limestone bedrock. See Plate No. 13, pp. 136-143 and the graphs in Appendix 7(a), (b), and (c), pp. 253-255.

The picture (above) is an elevation view of the completed bridge. The bridge is located on P.T.H. No. 44; Site No. 4. The picture (below) shows a steel H-pile under test load at the site.

The picture (above) shows a five span bridge, each span 67.5 ft (20.57 m) long, for an overall length of 345 ft (105.16 m). Located on P.T.H. No. 75 near St. Jean, Manitoba, (Site No. 2542, Plate No. 27(a), (b), (c) and (d), pp. 192-199) one of the busiest truck routes between Winnipeg and the U.S.A.; this bridge, although designed to accommodate the 32000 lb (142.3 kN) tandem axle loads, has performed well under repeated higher permissible wheel loads. A unique feature is that the superstructure was built using shallow depth prestressed precast concrete box beam, topped off with a concrete deck overlay bonded by an "Epoxy Resin" coating. This was the first time this system was specified in our province. The idea was to delay the bonding until the concrete wearing surface had hardened sufficiently to reduce the differential shrinkage as the concrete set, a system which has proven to be quite successful. (See Appendix 9, p. 257, "Specification for Concrete Topping on New Surfaces"). Built during the winter of 1967, the bridge has performed adequately to this day even with the increase in highway truck loading. The picture (below) was taken inside the housing used to protect the concrete topping from freezing.

Although a steel wire mesh was used in the overlay, no spalling of the wearing surface is evident today, probably due to the protection afforded the steel by its embedment in the dense concrete medium.

Another special design feature used in this bridge applied to the foundation. The deep beds of Lake Agassiz Clays presented a need to support the foundations on timber friction piles. Sub-soil investigation revealed that the clay bed capped off high artesian water pressures in the gravelly till below. (See Chapter 2, Page No. 85, Table 3 for more information on the design of the footings and the pile load test results).

The picture taken in May, 1979 (above, left) is of a bridge over the Souris River near Hartney, on P.T.H. No. 21, located E. of Sec. 17-6-23 W. in the R.M. of Cameron, Site No. 1151. The new bridge (picture, below) is 261 ft (79.55 m) long and 32 ft (9.75 m) wide, designed for HS 25 (MS225) truck loading. This bridge incorporates the new standard precast prestressed concrete superstructure to accommodate the higher design live loading. The unusual pioneering feature is in the use made of the existing pier foundations of the previous bridge.

Thorough investigation of the existing sub-soil conditions beneath the pier footings convinced the design engineers in 1980 to make use of the existing piers. The results of these investigations also indicated that the concrete in the old piers had sufficient strength and durability to safely support the new superstructure. The picture (above, right) shows the new cap on top of the old piers. Obviously, credit must go to the engineers in charge of quality control during construction in 1925. See Plate No. 26(a), (b), (c) and (d), pp. 184-191. The original bridge is a monument to another pioneer bridge engineer, Mr. Bruce Alexander Johnston who designed the bridge back in 1925, jointly with Mr. E. W. M. James. Mr. Johnston was President of the APEM in 1947 and 1948.

Known as the "Planky Plains" bridge, the pictures (facing page) show the three generation bridge types which evolved over the century for this location. It is situated where the Roseau River crosses P.T.H. No. 59, E. of Sec. 3-3-5 E. in the R.M. of Franklin, (Site No. 2397). The high flood waters and large ice floes occurring during spring run-off, as demonstrated in the picture (top) of the "Combination Howe Truss", had to be of major concern to the design engineer. The picture (centre) shows a downstream view of the 1956 treated timber bridge which was built using non-standard timber approach spans and was one of the first "Glulam Girders" in Manitoba. However, the deep timber girders did not improve the clearance above high water. See Plate No. 20(a) and (b), pp. 160-163. Regardless, it served well until it was replaced to improve the alignment of the highway and to accommodate the need to provide for the passage of larger and heavier truck traffic. The third site picture (bottom) shows the modern replacement structure; a two span, skewed prestressed precast concrete bridge with improved high water clearance. It was built in 1988 and is 200 ft 9 in (61.2 m) long and provides a clear roadway width 31 ft 6 in (9.6 m).

The bridge pictured below is located on P.R. No. 530 over the Cypress River, E. of Sec. 5-6-11 in the R.M. of Lorne. (Site No. 3075).

The above bridge has two special features incorporated in its design:

1. *The "Glulaminated" timber stringers serve as the top struts to support the high abutment retaining walls and the floor beams. The treated timber beams provided an economical alternative to the steel or concrete option, because timber has a very low coefficient of expansion and contraction, allowing the timber superstructure to act as a strut.*

2. *The walls of the abutments penetrate into the hard shale bed below the river and were placed neat against the sides of the excavation by using lean mix concrete backfill, and therefore footings beneath the walls were not needed. The bridge has performed well over the past thirty years, proving the effectiveness of the special techniques employed in the design. The design live loading was HS 20 (MS 180). See Plate No.22, pp. 168-171 for construction details.*

The picture of the St. Andrew's Locks and Dam (facing page, lower), courtesy of the Manitoba Archives, identifies the importance placed on this project in 1910. The historic event was followed by the construction of a movable span across the lock and the bridge approach spans at the east end. The elevation view of the bridge was taken in 1992. The consulting engineer was Mr. E. Brydone Jack, working for the Federal Government, Public Works. Today, in 1992 the public or the politicians don't seem to realize the tremendous benefits that the citizens of Winnipeg derive from the operation of the dam. It is located on P.T.H. No. 44 at Lockport, Site No. 2477. In addition to early commercial advantage for the fur and fishing industry, the City of Winnipeg has gained recreation advantages, such as boating up and down the rivers, which would not be possible without the higher levels of water maintained by the dam. The more recent bank enhancement along the Red River and the Assiniboine River near the "Forks" is another example of the benefits attained over the years. The bridge as a main highway crossing is and will continue to be of great benefit to the tourists, industry and local business, even if the heavy truck traffic is not permitted to use the bridge. This structure must certainly be preserved as a monument to the vision of Sir Wilfrid Laurier, one of our founding Prime Ministers.

Winnipeg, 1910 - Sir Wilfrid Laurier aboard the "Winnitoban" for official opening of St. Andrew's Locks

The picture above shows a bridge being built on dry land with the false-work support already partially removed, after the cast-in-place concrete had hardened sufficiently to carry the design dead loads. The opportunity to build the bridge on dry land made the cast-in-place concrete construction an economical solution. Built in 1953 the bridge cost $150,000.00, an economical solution when compared to the steel alternative. The picture below shows the completed structure with the diverted river flowing beneath. The author is identified as the design engineer.

The bridge is located in the east-bound lanes on the Trans-Canada Highway over the diversion of the Assiniboine River west of Headingly, Manitoba. The bridge is 352 ft (107.5 m) long and has a central clear span of 151 ft (46.0 m), See Plate No.19, p. 158.

ASSINIBOINE RIVER BRIDGE
IN THE TRANS CANADA HIGHWAY, NEAR HEADINGLEY, MANITOBA

2- Lane continuous reinforced concrete bridge having an overall width of 33'-6" and length of 352'-10"
Constructed 1954 Plan No. 2594

G. A. DE PAUW
DESIGN ENGINEER

A.A. LAUGHLIN
BRIDGE ENGINEER

The Heritage Bridge

This beautiful concrete arch was built in 1916 and is located on Prov. Road No. 352, in Sec. 31-14-13 W. in the R. M. of Lansdowne, over the Whitemud River; (Site No. 111). It has a clear waterway opening of 55 ft (16.76 m) and is 93 ft (28.35 m) long, and provides a clear roadway width of 18 ft (5.486 m). For more details see Plate No. 24, p. 176.

This well preserved structure was designed by Mr. M. A. Lyons, the first official Bridge Engineer for the Province and the first elected President of the APEM. This bridge can and definitely should be preserved as a "Heritage" structure. It is located in a "park-like" setting and because the road has been re-aligned the bridge will not be demolished to construct a new and more modern highway crossing. The feature picture on page 29 and the above were taken by Father Firmin Michiels in the summer of 1991.

Another "Heritage" candidate exists over the Roseau River near Gardenton, Manitoba. It is located N. of Sec. 35-1-6 E. in the L.G.D. of Stuartburn, on the access to Prov. Road No. 209; (Site No. 381). Built in 1918, this unique "Howe Trussbridge", supported on stone masonry foundations was designed using steel rods for tension members and timber for the compression members. See Plate No. 15, p. 146 for details. The pictures (overleaf) were taken on Nov. 9, 1992. The design engineer, Mr. N. B. MacTaggert was one of the first members of the bridge staff for the Province and therefore among the pioneers.


ROSEAU RIVER

Pioneering in Modern Steel Bridges

The picture below is of a northern bridge site over the Sasagiu Rapids on P.T.H. No. 6, in Sec. 15-71-7 W., in the Local Government District of Mystery Lake; Site No. 3067. Built in the winter of 1963 some thirty years ago, it supports heavy truck traffic transporting the products for the mining and timber industries. It is a three span continuous steel-concrete structure providing a clear central span of 125 ft (38.1 m). The bridge was designed for HS 20 (MS 180) and upgraded to HS 25 (MS 225). Its overall length is 188.3 ft (57.39 m) and it is 28 ft (8.53 m) wide. For more details see Plate No. 21(a) and 21(b), pp. 164-167.

Its unique feature is that the ends of the welded steel girders were anchored into the abutment to resist an upward reaction. This stress system allowed for a longer central span and short end spans to fit into the rock topography and clear the natural aesthetic beauty of the turbulent waters flowing over the rocks beneath. The abutments were pre-loaded to the top of the granite bedrock by means of 1¼ in (31.8 mm) steel stress rods. The steel rods were anchored 10 ft (3.05 m) into the bedrock with a non-shrink grout and were tensioned up to 60 ton (534 kN). The design engineer, Mr. Jack Brown invented a special bearing to act in both compression and tension and still allow for horizontal expansion and contraction movements.

The building of a bridge over the Churchill River near Leaf Rapids in northern Manitoba was truly a pioneering effort. The pictures (facing page) show the spectacular nature of its design and erection. The 235 ft (71.63 m) centrally supported truss was assembled on shore and floated into place on barges. The bridge is 614 ft (187.15 m) long spanning 423 ft (128.93 m) between piers. Although it was only designed to safely allow an HS 20 (MS 180) truck loading, the bridge has supported much heavier trucks hauling mining products, but not without deck maintenance problems due to excessive live load deflection of the deck system. See Plate No, 28 (a) and 28(b), pp. 200-203 for more details. Note that an especially heavy end section was specified for the steel piles, to be driven through dense gravel containing cobbles and boulders. All planned activities were successfully accomplished in the field, without any complications; thanks to the excellent supervision of the engineers. Mr. John Zuk was the consulting engineer in charge of the design and the engineering supervision. The steel superstructure was fabricated and erected by Dominion Bridge Co.

To take cross-sections of the river bed, echo-sounding equipment was operated off the side of the helicopter pontoon by Mr. Honorè Chartier, bridge inspector and technologist employed with the bridge division of the Highways Department. The river is almost 30 ft (9.14 m) deep at this crossing and flows so rapidly that the water does not freeze over in 50 degrees below Celsius weather conditions.

The picture on page 21 was taken circa 1908. It shows the bridge being built over the Assiniboine River on First Street in the City of Brandon, replacing an earlier bridge, which can be seen in the lower right corner. The building in the background of the 1908 picture still stands and is seen above beside the new bridge now in place. The first combined river and railway crossing is illustrated in Plate No. 38, p. 234. The Canadian Pacific Railway having come through the city along the south bank of the river, the need was created to build a high level crossing and an approach ramp onto the main structure for access from Assiniboine Avenue. The present bridge and railway overpass built in 1970 is 712 ft (217.1 m) long and provides for four lanes, two south bound and two north bound with a 4 ft (1.22 m) median and a 5 ft (1.52 m) sidewalk on each side, but does not provide access onto Assiniboine Avenue. The picture of the existing bridge was taken from Assiniboine Ave., looking east. The location reference is Site No. 2582.

On October 25, 1961 the new bridge over the Assiniboine River on 18th St. in the City of Brandon, Site No. 3001, was officially opened by the Honourable John Thompson, Q.C., Minister of Public Works. The bridge was named the "David Thompson Bridge" in honour of the first person to map the Brandon-Souris region and "Stoney" Assiniboine river around 1797, (Picture, below).

The picture (above) shows the shallow depth continuous steel girders erected in a raised profile, ready to receive the cast-in-place reinforced concrete deck. After the concrete was cured, the superstructure was lowered over the piers on top of the permanent bearings to final grades, thus inducing compression in the concrete flange and reducing the compression stresses in the bottom flange of the concrete-steel composite section over the piers in the areas of negative moment. This permitted the use of the shallow 36 in WF steel girder 260 lb/lin ft allowing better clearance above high water at the time of floods without raising the approach grades leading onto the bridge. Built in 1961, the two lane bridge has performed well into the nineties. Its centre span is 134 ft (40.84 m) long and its overall length is 351 ft (106.98 m). See Plate No. 35(a), (b) and (c), pp. 220-225 for details of construction and deflection characteristics. The hand written calculations, over one hundred pages, are the most detailed and neat set known to exist in the design files of the bridge office. This uniquely post-tensioned structure was designed by Hugh Cowley, P. Eng. He was a design engineer and the Assistant Chief Bridge Engineer from April 30, 1953 to June 5, 1987.

The pictures (facing page, top and bottom) show the steel superstructure being erected off the barges in the Red River north of Selkirk, Manitoba; Site No. 1662. The steel contractor, Dominion Bridge Co. is moving a support bent, which is supported on top of the barges, into place in readiness to lift the large welded steel girders into position on top of one of the river piers. The time of year is October, 1986. All the steel work was successfully completed before freeze-up that fall. The steel-concrete-composite portion of the bridge spans the river and is 1026.25 ft (312.8 m) long and the main span over the navigation channel is 285 ft (87 m) long and provides vertical clearance above average summer water level of 60 ft (18.3 m).

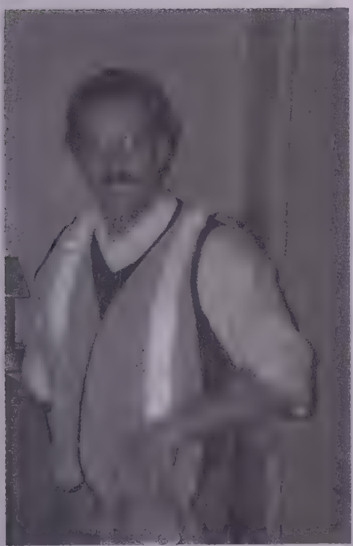
It is interesting to note that the bridge built in 1935 approximately seven kilometres upstream in the Town of Selkirk provided clearance to elevation 790.0 ft (240.79 m) which is 64 ft (19.5 m) above the max. flood level which occurred on April 22, 1923, while the new bridge downstream of Selkirk provided clearance to elevation 775.26 ft (236.3 m), which is approx. 15 ft (4.57 m) lower. However, the vertical navigation clearance provided in 1986 was approved as sufficient to allow the passage of sail boats with 50 ft (15.24 m) high masts during the summer navigation season. The cost of raising the height of a fixed span was considered not to be economically justified when no water craft (sail boat) existed to date which required more clearance and since Lake Winnipeg is now regulated, so theoretically the maximum water level at this new site should not exceed 715.22 ft (218.0 m) above sea level. Furthermore, the method of providing the clearance for navigation by using a lift-span made the cost of providing extra vertical clearance less of a financial penalty. It would be interesting to know if the mast on the York boats would have been over 60 ft (18.3 m) high. To the best of the author's knowledge the old bridge was never raised more than forty feet to allow for the passage of any modern pleasure craft using the water-way.

The new bridge located just north of St. Peter's Church, on P.T.H. No. 4 is over one half mile long (849 m) and is the longest bridge in the province. The approach spans consist of prestressed precast concrete girders made continuous over two piers and acting compositely with the concrete deck. See Plate No. 37 (a), (b) and (c), pp. 228-233 for details. Note the innovative design of the main river piers.

The picture (following page) taken inside the Dominion Bridge Co. plant shows the "Linde" continuous submerged arc welding equipment joining the steel web plate to the flange of a large girder. The position of the girder as shown is the key to producing a sound weld, preventing undercutting of the plate, according to Gordon Koch, P. Eng., plant superintendent for the company. The development of the automatic submerged arc welding equipment and the welding technique revolutionized the bridge building industry by providing the capability to fabricate these specially designed plate girders, replacing the old riveted system employed on the earlier steel bridges previously identified. The first fully automatic submerged arc welding system was used in the construction of the...(continued on p. 57)

steel plate girder bridge over the Assiniboine River on P.T.H. No. 34, north of Holland, Manitoba in 1952. However, two other changes in the evolution of bridge work had to occur before the new fabricating capability could be fully utilized; these being the availability of the cranes needed to lift these heavy sections and the transportation capacity to deliver the sections to the site (see center picture, p. 54). Ironically, the capacity of the existing bridges to permit the passage of these overload vehicles became one of the more serious obstacles to the use of these heavier bridge components, this being especially true in the selection of alternative precast concrete systems.

The picture (above) of the Red River (Site No. 1662) was taken on April 11, 1986 at 11:30 a.m., just after the ice jam moved, pushing ice blocks up against and on top of the newly constructed foundations.



Orèl Kiazyk (picture, left) was the person whose duty it was to inspect the fabrication and welding of the steel sections for this bridge. He was the first "on-staff" Technical Officer to hold the title of "Welding Inspector". He started with the Department in April 1977 and holds a "Certificate of Welding Inspection" from the Canadian Welding Bureau, after passing the Canadian Welding Development Institute examinations in Welding Fundamental Principles and Practice.

The completion of the bridge construction provided the incentive to unofficially install a time capsule on the bridge. Unofficially named "St. Peter's Bridge" inside the capsule, the steel container holds documents with the names and titles of all the key participants involved in the design and construction of the bridge being dubbed by the public as "The Bridge to Nowhere" caused some embarrassment to the government of the day, consequently no ribbon-cutting ceremony to officially open the bridge to traffic took place. Nonetheless, this bridge is one of the most impressive structures existing in the Province. It was designed for HS 30 (MS 272) live loading (See Plate No. 39, p. 236) using the most advanced engineering technology known. The bridge will provide the route for the crossing of the Red River with heaviest of loads and will attract industry into the area.

The picture below taken beneath the deck of the bridge on August 12, 1988 shows the time capsule, and Walter Saltzberg, the Senior Construction Engineer (centre); Charlie Feuer (left), the Resident Engineer; Alfred Cornies (right), the Assistant Construction Engineer; and the author behind him; all Professional Engineers working for the Department, and Norman Ulyatt, P. Eng. (second from left), the Senior Design Engineer with M, M. Dillon Ltd., the consulting engineering firm responsible for the design of the bridge. Missing from the picture is the on-site resident consulting engineer Robert A. Wiebe, P. Eng. who supervised the construction of the foundations on this challenging project.

2

The Engineering Disciplines in Design

Preface

The design of a bridge is an art involving special technical skills. The many factors to be considered were very skilfully expressed by Gene R. Cudney when he wrote the following;

> *"A highway bridge subjected to moving traffic represents a highly complex stress system. The applied traffic loading is a function of the vehicle type, axle spacing, axle load distribution, vehicle speed, relative vehicle position on the span, surface condition of the approach pavement and bridge deck, and the inherent vehicle dynamic characteristics. The response of the structure itself is, in turn, a function of its dynamic characteristics involving the type of span, stiffness, mass, and damping behavior. In addition to this dynamic aspect of loading, the bridge is subjected to an initial relatively constant state of stress involving the dead load, effects of shrinkage and creep, and residual stresses inherent in the various fabricating processes. Further, the effect of environmentally induced forces, including differential temperature changes, add to the continually varying stress history to which the structural elements of the bridge are exposed. In actuality then, the stress histories of the structural components of a highway bridge comprise a series of random stress cycles of short duration, of variable frequency and amplitude, superimposed over a relatively slowly changing minimum stress level."*

A bridge has two main components: the substructure and a superstructure. The capacity of these components to withstand the forces acting upon them is determined by design engineers skilled in several disciplines of the applied sciences. A good bridge design engineer will have a basic knowledge in the field of soil mechanics; hydrology and hydraulics; structural analysis of timber, steel and concrete plus many more special materials (such as rubber, neoprene, glues and plastics used in bearings etc.). Consequently, no one person will be able to specialize in every discipline involved in the design of a bridge and a team effort is required to arrive at an economical structure to satisfy the parameters laid down for each site requiring a stream crossing or a traffic overpass.

Design Evolution

Researching of the bridge design office files for the heritage bridges did not uncover many design notes that might have been prepared by the pioneers. Yet, design calculations would have been done in order to permit the preparation of the detailed drawings included with this publication. The title boxes on the "Plate" exhibits attest to the responsibility the pioneering designers accepted, although their professional "seal" was rarely evident on the plans set forth from their hand. The slide rule and later on the mechanical calculator were probably the original tools used to carry out their design work. The author remembers the noise that emanated from behind Mr. James's office door as he manipulated the calculator while designing the bridge for the Red River crossing at Emerson, on P.T.H. No. 75. However, the slide rule was still very much in use by the time the author joined the bridge design office in 1951 but was being gradually replaced by electronic desk calculators.

The departments bridge design capacity was greatly enhanced by the employment of Charles Ireland, P. Eng. in 1957 and Jack Brown, P. Eng. in 1959. These two persons brought about the introduction of the digital computer for the design of bridges and will be remembered as the Pioneers of the computer age in the Department of Highways in this province. Mr. Ireland, who retired in 1992, recalls that the first computer actually used by the Bridge Office was the Burroughs E101, which had the unique feature of being externally programmed. Programs were stored on the pinboards which were then plugged onto sockets on the top surface of the main "desktop". In fact, the computer was as large as an office desk, but had a program capacity of only 120 steps. As near as can be determined the IBM 1620 computer must have made its debut sometime in late 1960 or early 1961. Mr. Ireland remembers using the manual calculations for the pier of the River Hills bridge as a check on the original pier program written for the IBM 1620. Mr. Ireland was mainly responsible for the development of the computer program for the design of river pier foundations. The first use of the program was for the design of foundations for the Brokenhead River Bridge on P.T.H. No. 44 in June, 1962. This 1620 IBM pier foundation computer program was extensively used from that time on and even loaned to the consulting engineering firms retained by the department to assist the bridge office in carrying out their design overload.

Mr. Jack Brown wrote the first usable computer program for the Burroughs E101. This program analyzed continuous steel girders, and was used in the design of the Sasagiu Rapids bridge (Plate No. 21, p. 164). He also wrote the Fortran II program, for the IBM 1620, to design a set of standard simple span steel plate girders, all of which greatly enhanced the design office's ability to carry out its work. Unfortunately for Manitoba Mr. J. Brown terminated employment on March 31, 1965. His contribution to the development of the computer design capacity for this province is worthy of record, with special recognition.

The updating of the computer programs to keep up with the ever changing design codes was a never ending task. The first reference to a design code is found on Plate No. 3, p. 116, Bridge Plan No. F17, March 14, 1914. It makes reference to the Manitoba Government Specification, 1912, and Cooper's 1909, (a railway design code). On Plate No. 7, p. 124, we find reference to the Canadian Engineering Standards Association Specification No. 6-1922. This was probably the forerunner to the Canadian Standards Association's Specification S-6, for Design of Highway Bridges. Further development ultimately led to the adoption of the latest Standard Specification for Highway Bridges as published by the American Association of State Highway and Transportation Officials; a very voluminous and comprehensive all-inclusive document, and together with the latest Canadian Standards Association (CSA) Specification CAN3-S6-M78 metric version; the modern bridge design engineer is presented with a formidable and highly complicated technical set of guides to execute his assignment.

Design Live Loads

The selection of both the weight and the configuration of the truck to be used for the design of a bridge is of paramount necessity before the selection of the type and size of the structural components can commence. The choice of such loads (forces) expected to act upon the structure has evolved over the years and has been embodied in Design Specifications and Codes (guide lines) to assist the engineer in doing his/her work and to ensure that some form of uniformity of load capacity exists in the country's roads and highways.

In 1908, for the bridge over the Assiniboine River on First Street in Brandon, the design load was a 15 ton (133 kN) traction engine, plus 30% impact, or a uniform live load of 100 lb/ft^2 (4.788 kPa). For further details see Plate No. 38, p. 234. Note that the design loading for the "Electric Cars" is in the weight range of the Canadian Standard Association Specification, HS 20 (MS 180) truck used for the design of the bridges built on the Trans-Canada Highway in the 1950's.

The same 15 ton (133 kN) weight as the traction engine above was used for the motor truck in 1922, Plate No. 4, p. 118, and still in 1927, Plate No. 7, p. 124, Std. e-43, except that the uniform live load was only 80 lb/ft^2 (3.83 kPa). The maximum allowable working stress level for steel in tension was set at 18,000 lb/in^2 (124 MPa), the same limit still specified by some codes in 1950. The above loading was used in the design of reinforced concrete bridges during those early years (see Plate No. 16(a),

p. 148, dated April, 1927) and it is reasonable to conclude that Mr. M. A. Lyons' bridge (Plate No. 24, p. 176, March, 1916) and the Assiniboine River bridge in the R.M. of Woodworth (Plate No. 30, p. 206, dated March, 1925) would have been designed for the same live loading. In spite of the fact that these bridges are restricted to heavier loading by posting, it is likely that they are accommodating maximum legal truck loading which is allowed on the highways in the 1990's.

Some of the bridges built between 1925 and 1935 were designed for a live load consisting of an 18 ton (160 kN) motor truck plus impact of 30% or a uniform Load of 100 lb/ft^2 (4.788 kPa) applied over the deck area.

In 1935, the design live load for the bridge over the Red River at Selkirk, Plate No. 31(a) and (b), pp. 208-211, was described by A. M. White, P. Eng. as follows:

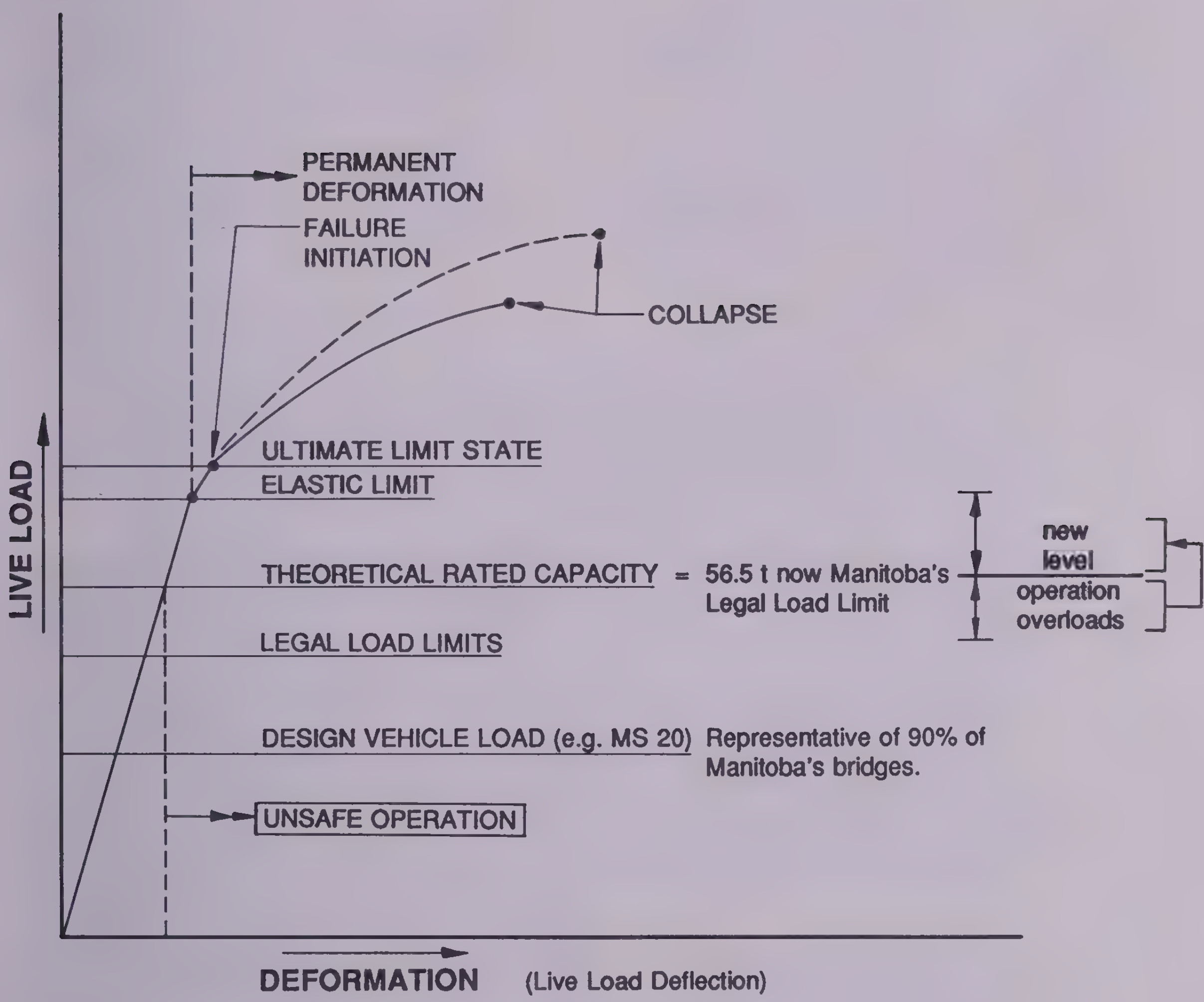
> *"The bridge was designed to C.E.S.A. Specification A-6-1929 for roadway load of 50 lb/ft^2 (2.39 kPa) plus 20 tons (178 kN) concentrated on a single line across the roadway with alternative roadway loadings of one 20 ton truck or two 12 ton trucks abreast." Re: (Appendix 5) "The Canadian Engineer", a Weekly Paper for Civil Engineers and Contractors, January 12, 1937, p. 251.*

Sometime in the late 1940's the Design Specifications adopted a motor truck weighing 20 tons (approx. 180 kN) it was known by the bridge design engineer as the H 20 vehicle. By 1951 a 16 ton (142 kN) trailer load was added to the vehicle which became known as the HS 20 design vehicle; or, if governing, a uniform load of 640 lb/lin ft (9.0 kN/m) of load lane plus a concentrated load was used as per the Canadian Standards Association's Standard S-6, for "Design of Highway Bridges". This loading was adopted for the design of the Trans-Canada Highway.

Since then, trucking industry lobbying has resulted in an ever-increasing array of legal loading. These higher allowable legal loads are often greater than the theoretical working design capacity of the bridges in the highway system. By 1960, the chairman of the Canadian Good Roads Association's Subcommittee on Bridge Loading Investigation outlined the status of loading to date, and identified the need to look ahead and recommended adopting a standard design load of HS 25 (MS 225). Had this been approved the modern heavier semi-trailer trucks could more safely move across our nation today. But false politically influenced economics dictated otherwise.

By 1984, the effects of the heavier legal vehicles equalled or exceeded those of the design vehicles. The evolution of design truck loads is illustrated on Plate No. 39, p. 236. It was prepared by Lorne Lautens, P. Eng., Chief Design Engineer for the Bridges and Structures Branch of the Manitoba Dept. of Highways and Transporta - tion. The chart clearly shows that the whole question of legal loads versus design loads has become very complicated and nonuniform throughout Canada and United States of America. Yet in retrospect, the author in a paper he wrote on "Current Highway Loads and Bridge Design" dated

CONCEPTUAL BEHAVIOUR OF A HIGHWAY BRIDGE



Note: The maximum allowable live load deflections becomes the limiting factor

FIGURE 1

July 15, 1963 concluded that "Indeed, a Royal Commission should be set up to look into all phases of land transportation and make recommendation to Ottawa for positive legislation" regarding this issue. Unfortunately, nothing was done.

Figure 1, (previous page) showing the Conceptual Behavior of a Highway Bridge provides an excellent theoretical relationship between the loads used in design and the limits associated with the overloads. Although disastrous collapse of a superstructure is not likely in most standard types of bridges (except for trusses, picture right), not many drivers would feel secure if the live load deflections were of such magnitude that they became noticeable when crossing the bridge.

Too often the manager engineer is not cognizant of the reasons and justification for the selection and use of safety factors introduced in the working stress design method, these being to allow for the following;

1. Faults or weaknesses in the construction materials, these materials not being fully homogeneous.

2. Deterioration with time.

3. Variation in the application of load from the assumed design arrangement.

4. The difference between the theoretical and the actual loads, and load concentrations.

5. Uncertainties of computed stress due to theoretical assumptions to simplify design formulae, the load distribution, and other unknown secondary stresses.

6. Normal variations in the size of the structural members and residual stresses introduced during the manufacturing process.

7. Rib-shortening stresses due to the expansion and contraction associated with changes in temperature and brittle fracture which can occur under extremely cold temperatures.

The vehicle on the bridge impacted the end chord member of the truss causing its collapse. The bridge is located over the Assiniboine River south of Portage la Prairie on Provincial Road No. 240.

Hydrology and Hydraulics

The pictures below, taken May 4, 1979 of the flood waters in the Red River Valley, show a part of the huge lake which formed along Highway No. 75 from the U.S. border north to where the floodway diverts the water around the City of Winnipeg. The top picture is a farm yard near Lettelier, Manitoba and the bottom picture shows the Red River flood waters backing up the Morris River near Rosenort. The water craft in the centre of the lower picture is a rescue boat operated by the bridge division's maintenance crews taking poultry and live stock out of the flooded farm buildings. Mr. William Huff, construction superintendent, and his men received a special citation for their dedication and long hours of effort put in helping the victims of the flood.

The location of a highway through a valley is often dictated by desirable road geometrics making the hydraulic problems for the bridge engineer more difficult, especially if a heavy skew results; that is, the angle between the direction of flow in the riverbed below and the perpendicular to the road alignment above. It is difficult enough to achieve an economical pier-girder span relationship, without introducing the added complication involved in the design of a skewed superstructure, and the need to accommodate the direction at which large ice floes will impinge on the pier foundations; all adding to the special design problems which increase the ultimate cost of the bridge. Our pioneering predecessors had more input regarding the location of the road alignment; this observation is made from examining the old bridge plans, most of which cross the river at right angles and where rapids occur, this being where the distance between defined river banks is the least and the river beds are the most resistant to erosion. In recent times the volume, size and type of traffic and the speed at which it travels, along with the cost of acquiring right-of-way overrides the bridge design considerations. Nevertheless, a skewed river crossing is an "abortion" and should be avoided, if reasonably possible. One of the solutions has been to divert the river alignment. Plate No. 19, p. 158, and pictures on p. 46 provide an example of such a project. It also made the construction of a cast-in-place reinforced concrete bridge an economical alternative solution, enabling the construction of false-work in the dry by diverting the river beneath the bridge after the construction of the bridge had been completed.

An important element involving the selection of the bridge length is the determination of the desirable size of the waterway opening through the road and/or beneath the bridge. This involves the need to do hydrological estimates concerning run-off; which is sometimes as difficult as predicting the weather fifty years hence. Determining the volume of flow that the waterway opening must be able to pass without causing the foundations to wash out or the road approaches to scour out from behind the abutments is not readily achieved but must be of major concern to the bridge engineer.

In the pioneering days major flood flows would overflow the approach roads and not create a crisis. The bridges over the Assiniboine River at Site No. 7451, Plate No. 30, p. 206 and the Souris River at Site No. 1151, Plate No. 26(c), p. 189, are locations where this phenomenon occurred, leaving the bridges in place for over 65 years. In those early days, the temporary disruption to the passage of local farm vehicles did not create a major problem.

The picture above of the ice pressing against the upstream side of the steel truss located over the Red River at St. Jean on P. R. 246 (Site No. 2465) was taken on April 12, 1978. It shows another example of the bridge maintenance crew's willingness to serve the public at great personal risk; note the men setting dynamite charges beneath the ice sheet, in an attempt to break it up and thus relieve the force threatening to lift the bridge off its foundations. The picture below taken April 21, 1948, shows the successful effort which was made to load down the timber approach spans to prevent them from floating off the top of the pile bents. The flood waters were over flowing the east approaches to the bridge, alleviating some of the pressures acting against the superstructure. The village of St. Jean, Manitoba can be seen in the background.

However, in recent times the approach roads are not to be over topped and consequently all the water which previously overflowed the approaches must now pass through the waterway opening beneath the bridge. This places even more responsibility on the hydrologist and the hydraulics engineer by requiring them to establish a risk factor against washout in that the design of the waterway opening must now relate to the possible frequency of highway closure and danger to the motoring public due to major floods. To do this the engineers have established design standards which set out acceptable recurrence probabilities with regard to the importance of the traffic artery. The "Guide to Bridge Hydraulics" published by the Project Committee on Bridge Hydraulics of RTAC is an excellent reference dealing with this engineering discipline.

In the beginning of the century statistics reflecting flow data were not available and frequency discharge curves could not be developed to assist in predicting the magnitude of say, a 2% flood; that is a flood which has the probability of occurring once every 50 years on the average but the potential of occurring and exceeding that magnitude next year. The 1950, 1969 and 1979 floods in the Red River Valley were of such magnitude that vast lakes formed over the cultivated lands. This type of flooding makes the hydraulic determination of the quantity of flow for the selection of the waterway opening beneath the bridge a very difficult task because of the vast storage of water covering the affected areas.

The 1976 flood in western Manitoba was an event of major proportion, probably the maximum recorded flow in the history of the Souris and the Assiniboine Rivers. The 1960 predictions of the rate of flow that might occur within the next 50 years (2% frequency) was estimated to be approx. 9600 ft^3/s (272 m^3/s), yet the recorded flow in the Souris River at Wawanesa in 1976 was in excess of 26,000 ft^3/s (736 m^3/s).

Just to touch on the subject of hydrology, this book includes the results of a study of the flood design properties of the Souris River Basin (Plate No. 33, p. 216) by examining the many frequency curves of the various tributaries emptying into the Souris River. Figure 2, p. 71, shows the plots of the data (Table 1) extrapolated from the frequency curves allowing the derivation of the run-off formula $Q_{\%}=cA^x$. From the examination of the data extrapolated from the frequency curves for Gauging Stations on the Souris River itself, (Table 2), it was concluded that a separate relationship had to be developed for the annual peak discharge verses the drainage area. Figure 3, p. 73, demonstrates that indeed a good straight line results when the data is plotted on a full logarithmic, 1x1 cycle graph paper; which means that a curve of the power form can be fitted to the data, in fact more correctly so, than was done for the river's tributaries. The resulting formulae are given in Figure 3. Although earlier studies have indicated that the exponent of the power curve would not be expected to exceed one (1.0), reliable results using these equations are obtained.

The picture above is of the original bridge constructed in 1921. This bridge is located over the Souris River E. of Sec. 5-8-16 W. in the R.M. of South Cypress on Prov. Road No. 340, (Site No. 412). The picture (below) was taken during the 1976 flood at the time the north abutment was failing. An interesting note on the original plan proposed a revision to the north abutment pile design. One wonders if the longer piles originally specified had been incorporated and driven to full penetration, whether or not the washout in 1976 might have occurred. Subsequently, long steel H-piles were driven to greater depths to support the replacement treated timber standard spans. See Plate No. 25 (a), (b) and (c), pp. 178-183 for more dimensional details.

Table 1

Run-off Data for Tributaries in the Souris River Basin
Annual Peak Discharge versus Area
Extrapolated from "Frequency Curves" by
Harden, W.R.B.

Description of Gauge Location			Gross Drainage	Volume, m^3/s	
Station No.	Creek	Near Town of	Area, km^2	$Q_{2\%}$	$Q_{3\%}$
05 NF 008	Graham	Melita	730	26.0	20.5
05 NF 015	Jackson	Melita	493	28.5	22.0
05 NG 019	Stoney	Broomhill	460	40.0	32.0
05 NG 020	Medora	Napinka	317	50.0	40.0
05 NG 010	Oak	Stockton	1031	50.0	44.0
05 NG 012	Elgin	Souris S.	1173	54.0	47.0
05 NF 003	Gainsborough	Melita	1469	65.0	55.0
05 NF 007	Gainsborough	Lyleton	1146	68.0	55.0
05 NG 007	Plum	Souris	5379	102	75.0
05 NG 003	Pipestone	Pipestone	4203	112	98.0
05 NF 002	Antler	S. Melita	3215	140	118
05 ND 004	Moose Mountain	Oxbow	6051	168	150
05 NB 001	Long	Estevan, Sask.	4842	190	165

The data plotted on Logarithmic, 2 x 2 cycles graph paper shows that a considerable scatter results making it difficult to resolve a straight line relationship. However, by applying a mathematical solution, the following formula assuming a curve of the power form results:

$$Q_{2\%} = 0.681717\ A^{0.630892}\ m^3/s \qquad Q_{3\%} = 0.508052\ A^{0.645229}\ m^3/s$$

where the area "A" is in kilometres squared. See Figure 2.

or

$$Q_{2\%} = 13.207277\ A^{0.630892}\ \text{c.f.s.} \qquad Q_{3\%} = 9.709388\ A^{0.645299}\ \text{c.f.s.}$$

where the area "A" is in square miles

REGIONAL RUN-OFF POWER CURVES FOR THE TRIBUTARIES OF THE SOURIS RIVER "Q" m^3/s VERSUS DRAINAGE AREA - km^2

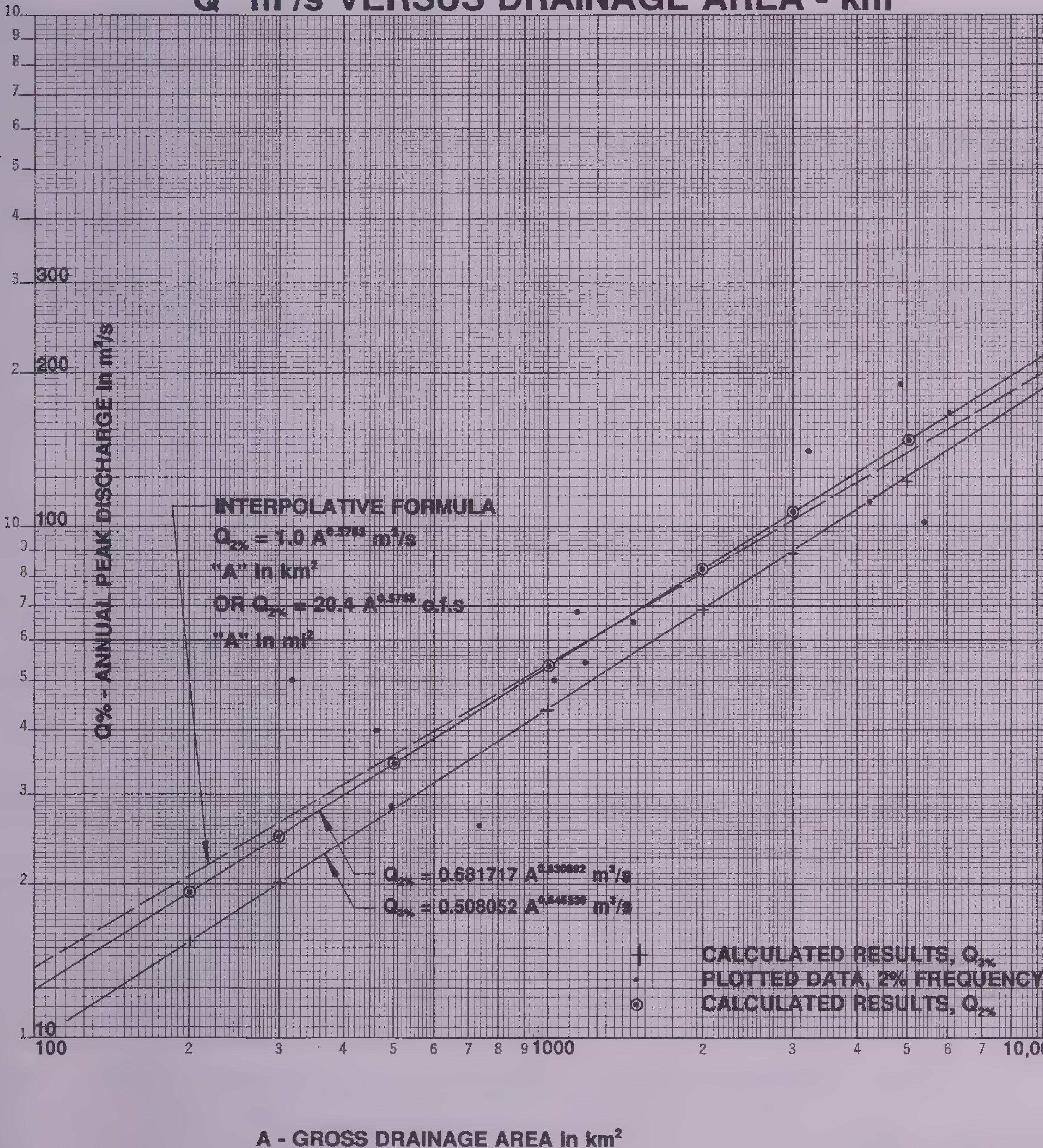


FIGURE 2 (TABLE 1)

Table 2

Souris River
Gauging Station Data,
Period between 1913 - 1990*

Station No.	Location Name	Drainage Area, km^2 (Logarithm of Gross Drainage Area/1000)	Quantity of Flow in Cubic Metres/Sec. Percent Frequency of Occurrence		
			2% (log Q)	3% (log Q)	5% (log Q)
05 NF 012	near Westhope, North Dakota	43,000 (1.63468)	300 (2.477121)	246 (2.390935)	192 (2.253301)
05 NF 016	near Coulter, Manitoba	43,184 (1.635323)	310 (2.491362)	260 (2.414973)	198 (2.296665)
05 NF 009	near Melita, Manitoba	48,961 (1.6898501)	385 (2.585461)	315 (2.498311)	235 (2.371068)
05 NF 001	at Melita, Manitoba	49,880 (1.697926)	400 (2.602060)	325 (2.511883)	245 (2.389166)
05 NG 021	at Souris, Manitoba	58,717 (1.768764)	535 (2.714330)	425 (2.628389)	320 (2.505150)
05 NG 001	at Wawanesa, Manitoba	60,300 (1.780317)	560 (2.748188)	450 (2.653213)	340 (2.531479)
	Ave. Log A, Pt. X_1	(1.652880)	Pt. Y_1 (2.51-7981)	(2.434740)	(2.317011)
	Ave. Log A, Pt. X_2	(1.749002)	Pt. Y_2 (2.6928-66)	(2.597828)	(2.475265)

from which $Q_{2\%} = 0.32413\ A^{1.819407}\ m^3/s$

and $Q_{3\%} = 0.42691\ A^{1.696677}\ m^3/s$

and $Q_{5\%} = 0.39421\ A^{1.646387}\ m^3/s$

where "A" is the gross drainage area in kilometres squared divided 1,000

or

$Q_{2\%} = 2.02638\ A^{1.819410}$ cubic feet per second

$Q_{3\%} = 2.99956\ A^{1.696677}$ cubic feet per second

$Q_{5\%} = 2.90561\ A^{1.646387}$ cubic feet per second

where "A" is the gross drainage area in square miles divided by 1,000

* Values extrapolated from frequency curves as per "Harden" with the Water Resources Branch, Department of Natural Resources, Province of Manitoba

THE SOURIS RIVER RUN-OFF POWER CURVES
"Q" m³/s VERSUS DRAINAGE AREA - km² ÷ 1000

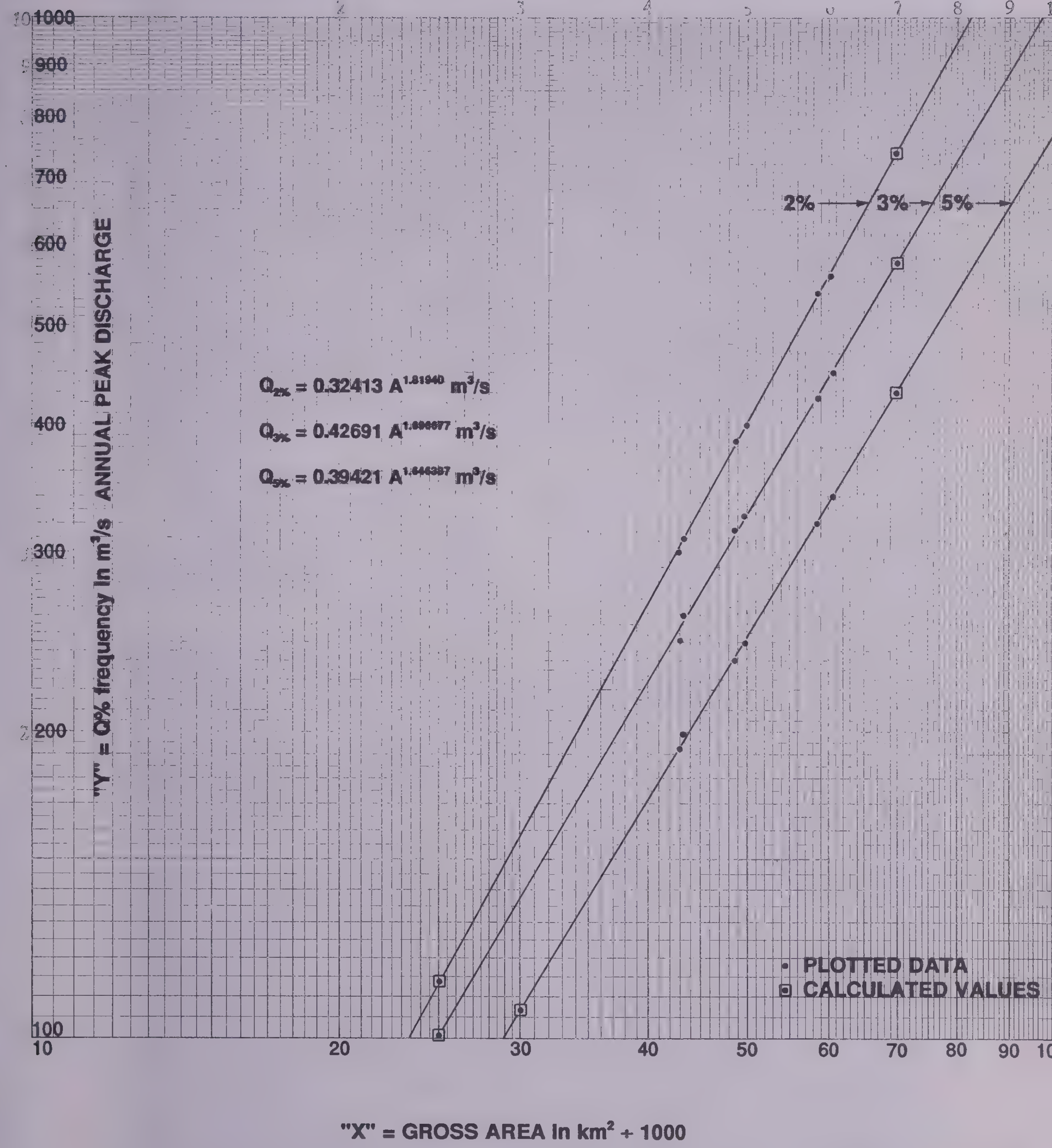


FIGURE 3 (TABLE II)

The cast-in-place reinforced concrete box culvert (typical shown above) is one of the most structurally stable types of hydraulic opening that can be installed beneath the highway. Furthermore, it allows for the unrestricted width of roadway to carry across it. Therefore, it is often used as a modern replacement for the short span bridge. The pioneer designers also made good use of this mode of construction proving its beneficial use as a durable structure with good vehicle overload capacity.

However, the prediction for the size of the culvert required is complex because of the wide variables which have a bearing on the flow through the culvert. The outlet velocities are usually high when selecting an economically designed opening. In addition, the potential for flooding caused by backwater must also be carefully investigated and the possible restriction to the passage of fish is an environmental concern (see pictures on pages 75 and 77).

Studying and manipulating this data makes the hydraulic engineer realize how important the work of the Provincial and Federal Water Resources agencies is in obtaining and providing annual maximum peak discharge data.

It should be recognized that the magnitude of run-off will be an ever changing quantity; this being caused by man's interference with the natural phenomenon by the construction of drainage ditches around every square mile of land, the draining of pot-holes and the clearing of trees which existed along the road ditches and the pot-holes, and the construction of dams to store the water during peak run-off periods; all of which alters the historic run-off picture that the hydrologist must attempt to interpret.

It is appropriate at this point to recognize Steven Sapinski, P. Eng., B. Sc. and Master in Civil Engineering, U. of M.; who was the first engineer in the bridge design office to develop technically advanced methods for estimating the size of the water-way openings required through the roads and highways in this province. In addition he combined this knowledge of hydrology and hydraulics with his expertise in the field of soil mechanics to arrive at a total solution for a specific river crossing having stable slopes, which were not likely to scour out with the passage of a selected flood frequency.

Steve began his work with the Highways Department in December, 1957 and passed on from the earth he had studied so well on April 9, 1990.

STEVE SAPINSKI

The typical one-half through concrete arch span over the Souris River shown on page 69 and the bridge in the picture above is an example of the style of bridge designed by a Mr. Edward Sherburne Kent. He came to Winnipeg in 1912 and served overseas with the Royal Engineers during the first world war. He joined the bridge design group with the Dept. of Public Works, Highway Commissioner's Office in 1919. On Feb. 23, 1925 he is listed among the other pioneers in the bridge design activities during that period of engineering practice.

The bridge in the picture (previous page, top) was built in 1921, and is located on the east-west road allowance approximately two miles (3.22 km) west of Souris, Manitoba, over Plum Creek and the triple 10 ft x 10 ft (3.05 m x 3.05 m) reinforced concrete box culvert through P.T.H. No. 2 located downstream of the old site on the re-aligned highway in the N.E. Sec. 32-7-21 W., R. M. of Glenwood (Site No. 2503) was built in 1965. The picture (previous page, bottom) of the backwater effect caused by the culvert was taken during the peak flow which occurred on April 21, 1976. The head waters above the culvert created a large pond upstream of the highway flooding a large area of land. Note that the tops of the concrete arches of the old bridge are just visible to the left in front of the buildings and that the edge of the turbulence from the vortex in the picture (facing page, top) can just be seen in the bottom right corner.

The concrete box culvert would be considered hydraulically inadequate by today's standards, but it appears that the old bridge would have been hydraulically adequate to accommodate the estimated one in seventy-five year flood of 1976. The centre arch span is 70 ft (21.34 m) long with 23 ft (7.01 m) end spans for an overall length of 116 ft (35.36 m). The concrete in the bridge is sound and although only 17.33 ft (5.28 m) is still being used by the farmer in whose field the bridge is now located. This lovely concrete structure, because of its present location could easily be preserved as an historic monument to the pioneering bridge design engineers of the province. Unfortunately, plans of the bridge were not kept on file in the bridge office.

The ponding created a 19.22 ft (5.86 m) head above the upstream invert of the concrete box and generated a huge vortex (facing page, top) and rapid super-critical flow within the barrel, resulting in the turbulent outlet velocity theoretically estimated to be 25 ft (7.62 m) per second for an all time maximum recorded flow of 5380 ft^3/s (152.35 m^3/s) (facing page, bottom).

The 1976 flood in the Souris River Basin provided an excellent opportunity to study the run-off characteristics of the drainage area.

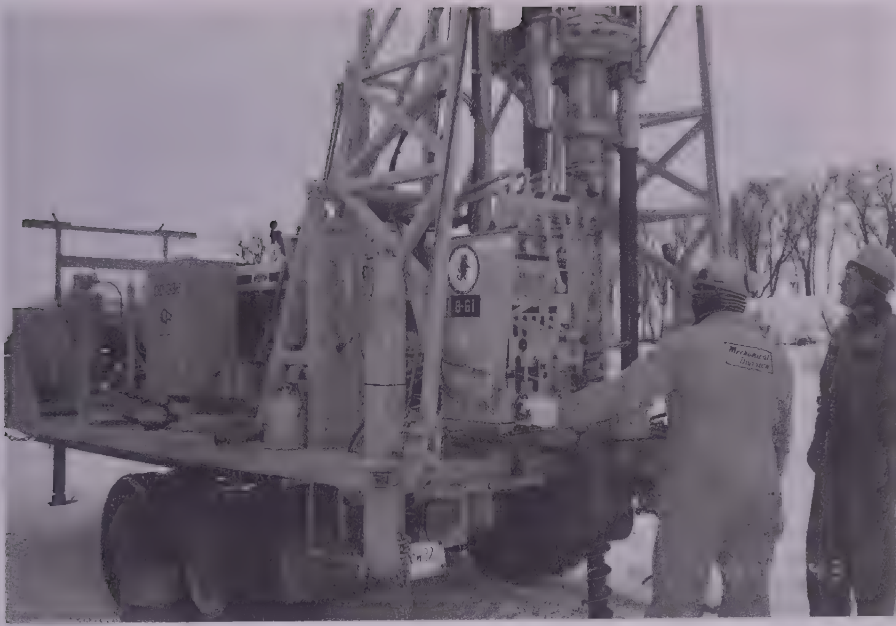
Bridge Foundation Stability - River Banks

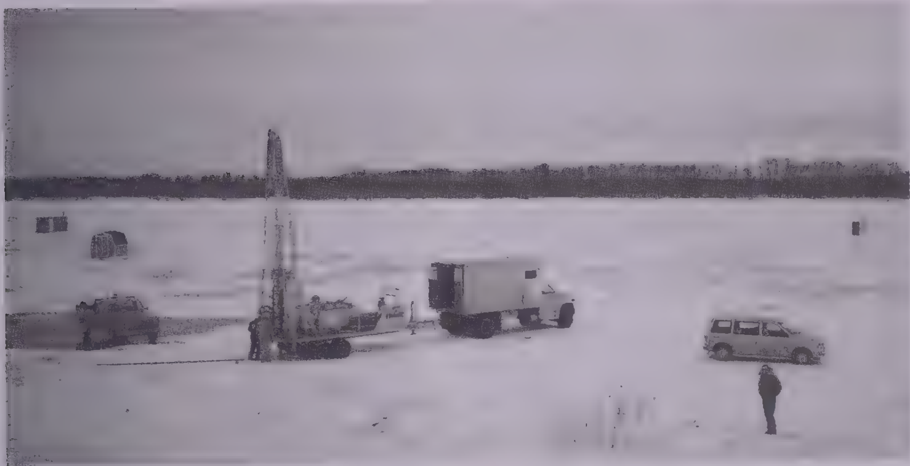
Engineers have always recognized the importance of having a thorough knowledge of the soil properties in the river banks and below the river bed, before starting any design of a bridge crossing. Evidence of this fact is borne out by noting that the pioneers in bridge design for this province had obtained subsoil logs as early as 1913 for the design of the Provencher Ave. bridge. (See page 16). Plate No. 31(b), pp. 210 & 211 is a good example of the extensive investigation that had been done to determine the soil profiles beneath the river bed in 1935. The examination of such early soil information analyzed against the proven performance of the bridge still in place, and compared with the soil design parameters which can now be obtained with the latest drilling and sampling equipment, would be of tremendous value towards the enhancement of our future foundation design skills.

Around 1950, the chief bridge engineer acquired diamond drilling equipment to enable the Department to better investigate the sub-soil conditions at the bridge sites. The pictures of this equipment along with the sampling and *in situ* testing devices are shown on the following pages. See Plate No. 40, p. 238 for details of the "Drop Hammer and Attachments" used to take standard penetration tests, Bridge Office Drawing No, G.D. 21.

Anyone in the business of designing foundations located in a river bank should be fully aware of the undisputed fact that the foundation is only as stable as the river bank itself. The bridge division of the highway department has experienced a few situations where the driving of piles in the abutments and bank piers actually caused the initial bank failure even before the concrete could be placed for the pile cap. In two such situations the resident engineer was accused of making an error in locating the pile group, when it was shown later on that the whole pile group had slid downhill during the driving of the piles in the adjacent pier. The construction of the Red River bridges between Emerson and Winnipeg provided many opportunities to study these types of foundation movements.

The phenomenon was not restricted to the banks of the Red River but is typical for banks along rivers in the lake Agassiz area, including but not limited to, the Brokenhead, Assiniboine, Rat, La Salle and Plum Rivers and including Coca Cola Creek (Site No. 42). In some situations failure occurred after the bridge had been in service for some length of time-probable causes being traffic vibrations, increased surcharge loads, drawdown after floods receded, and weakening due to disturbance caused by construction activities. Unfortunately, once failure has occurred in the soft silty clay banks, it is virtually impossible to restore to the original stability by subsequent remedial work: that is, the shear strength in the slippage plane is of the remoulded magnitude and will always be less than the shear strength results obtained in the unconfined compression tests done on "shelby tube" soil samples





In 1963 the Department of Highways purchased diamond drilling equipment for the purpose of obtaining sub-soil data. New equipment obtained in 1988 was a later model of the Mobile B-61 Pace Maker. It is seen here on top of the ice in the Red River north of Selkirk carrying out soil investigation for a new bridge crossing.

The key items are the sampling and in situ testing tools used inside the seven inch hollow stem auger to establish important soil properties for foundation design. The sequence of pictures that can be found pages 81 and 83 illustrate the tools used for sampling and testing of the soils.

Mr. John Brown and his successor, Mr. Laurence Papuga, who joined the bridge office staff in Nov., 1966, both soils technicians, and Mr. Rene Gervais, the equipment operator were the men in the field whose joint efforts provided the very critical information needed to design the foundations in the bottom of the rivers and in the usually unstable banks. Mr. Papuga's hard work and dedication over the past twenty four years brought to the bridge design office a wealth of useful knowledge about the subsoils from all over this province.

in the laboratory; notwithstanding the thixotropic property of the clay soils.

Not enough value is placed on the usefulness of the *in situ* testing of soils by foundation engineers and soil mechanics experts. The *in situ* vane shear tester not only measures the value of the initial shear strength of the soil but provides a very useful parameter for analyzing river bank stability; that is, the sensitivity to disturbance. The moisture content of the clay and the degree of saturation is also needed to make an adequate appraisal as to bank stability since the major shifts in the position of the foundations are associated with floods.

The ratio of the *in situ* vane shear strength to the remoulded *in situ* vane shear strength is in the order of 1.5 to 2.0 for lake Agassiz clays of soft to medium strength; not high in terms of sensitivity. But should the sensitivity be in the order of 2.0 or greater special care in the design of the slopes is mandatory. In reviewing the design notes at many sites located in the lake Agassiz basin it was found that the average remoulded *in situ* vane shear strength in most clays is in the order of 418 lb/ft^2 (20 kPa), but in very soft clays with a sensitivity of 3.0 or greater the remoulded *in situ* vane shear strength will average around 292 lb/ft^2 (14 kPa) and stiff to very stiff clays with a sensitivity of 1.5 or less will have a remoulded *in situ* vane shear strength around 1040 lb/ft^2 (50 kPa).

Coca Cola Creek (Site No. 42) located in the Whiteshell Forest area near the Pine Falls dam was designed with bank slopes beneath the treated timber bridge of 4:1 using a safety factor of 1.5 based on unconfined compression test results; yet serious slippage occurred a few years after the construction of the bridge. Subsequent on site testing showed that the soft grey silty clay had an *in situ* vane shear strength of 900 lb/ft^2 (43.1 kPa) and a sensitivity of 2.6. On the other hand, the natural slope of the north river bank beneath the new bridge over the Assiniboine River on Provincial Road No. 305, southwest of Portage La Prairie had an average *in situ* shear strength of 550 lb/ft^2 (26.3 kPa) with a sensitivity of approx. 2.0, but still the abutment and piers in the bank moved over a foot after the spring runoff.

Reliable *in situ* vane shear test results can be obtained providing well designed soil sampling equipment is used and the standard procedures outlined in appropriate codes are followed.

Soils engineers should be sufficiently competent in the field of soil mechanics by now to be able to predict river bank stability problems.

The picture (above) shows a soils technician taking an in situ vane shear test through the hollow stem auger in the clay soil below the end of the auger penetration. (1963 photo).

The pictures (above) are of the automatic "Standard Penetration Testing Equipment" in place on the drilling rig, in readiness to obtain soil density parameters. See Plate No. 40 , p. 238, for details of this specially designed apparatus intended to ensure uniformity in the execution of the test.

Some of the solutions to riverbank stability problems are:

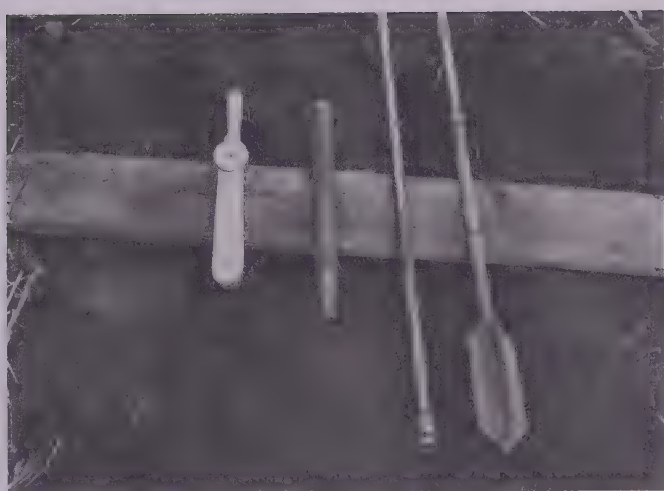
1. Have an experienced foundation engineer participate in the early planning stages and in the selection of a site crossing.
2. Reduce the amount of the surcharge load on the top of the river bank.
3. Design the substructure units and superstructure to accommodate the anticipated movement.
4. Flatten the slopes and build longer bridges on more innovatively designed foundations and thus minimize the creep movements.
5. Reduce the causes of vibrations during construction by employing techniques such as pre-boring holes for the placement of the piles and only driving to seat the pile.
6. Install slope inclinometers so that the movements of the bank can be monitored to provide time to plan remedial action before the situation becomes critical.

The bridge in the picture above was built in 1955, but because of severe riverbank instability had to be rebuilt in 1970. It is located over the Red River on P.R. 201 in the Parish of Ste. Agathe, in the R.M. of Franklin and Montcalm, Site No. 2733.

The bridge was modified by removing several timber approach spans at the west end of the former bridge and replacing them with an 11 ft 0 in (3.35 m) easily removable span and a 120 ft (36.57 m) steel truss. Two new reinforced concrete piers had to be constructed to support the 120 ft truss and the existing steel truss. The pier footing at the west end of the steel trusses is supported on eighteen 60 ft (18.28 m) piles. The pier at the east end is supported on 42 treated piles from the previous pier and in addition twelve 60 ft (18.28 m) timber piles, and seven 70 ft (21.34 m) long steel "H" piles driven to full penetration. Even then, as an added precaution, a special bearing beam was installed beneath the original sliding expansion bearing (as can be seen in the lower left part of the picture), to accommodate predicted continuous movement of the foundations.

And so, the battle to stabilize bridge foundations built in the banks of the Red River is never ending.

Soil testing apparatus in the picture left shows from left to right, the double barrelled core sampler with diamond bit, split spoon penetration cone and head and the "Shelby" sampler.



Apparatus for field vane testing, manufactured to the requirements of the Canadian Standards Association's Standard A-119.4, on boring and sampling.

Pile Load Tests

Over the last forty years the bridge division carried out several load capacity tests on driven piles to determine safe or allowable design loads. The information thus gained has been very useful in developing new design approaches. Each site had very different soil profiles and three types of pile material were used. Table 3, on the facing page, gives a very brief summary of some load capacity test results. It is significant to note that the shear strength values obtained by *in situ* vane shear test can give reliable design parameters to estimate the shaft friction capacity of a driven pile in cohesive soils.

Similarly the standard split-spoon penetration test results are invaluable to estimate the tip bearing capacity of piles embedded in cohesionless soils. The bridge division has accumulated a large amount of soil data all over this province which could be correlated against the performance of existing structures still in use and by studying the design notes in the files pertaining to these structures. The *in situ* split-spoon penetration test results are particularly beneficial in this regard because it is very difficult and most often impossible to obtain undisturbed samples of cohesionless soils for laboratory testing. Note for example the high end bearing pressures developed below the tip of the piles at Site No's 2582 and 4454 with "N" values from 60 to 100. It is also important to note that the compressive strength of the pile material is not the governing factor in estimating the allowable pile capacity. Even the compressive stresses acting on the end of the timber applied parallel to the grain is only one half of the proportional limit.

The "Standard Penetration Test" procedure provides for the driving of a 1⅜ in I.D. by 2 in O.D. splitbarrel sampler with a 140 lb hammer falling 30 in. The blow count is recorded for each 6 in increment, with the sum of the second and the third increments being "N", or the standard penetration count. The test procedure is outlined in AASHO Designation T 206-64.

Reference: "Manual on Foundation Investigations" developed by the Operating Committee on Bridges and Structures of the American Association of State Highway Officials, 1967.

Table 3

Pile Load Test Data

Location References		Type of Pile	Length		Ultimate Load		Allowable Load		Soil Strata Description into which Pile is Embedded
Site No.	Plate No.		ft	(m)	tons	(kN)	tons	(kN)	
2542	27	Timber	55	(16.8)	68	(605)	34	(302)	Deep medium to stiff clay, estimated end bearing tip capacity approximately 2.5 to 4.0 tons, or (22 to 35 kN).
2542	27	Timber	25	(7.6)	28	(249)	14	(126)	
2582*		Timber	18.5	(5.6)	89	(792)	30	(267)	Firm sand, silt and clay, with tip driven into hard black clayey silt (shale), "N" ≥ 61.
4454		14" Hex. concrete	29	(8.8)	315	(2802)	160	(1423)	Buff till and silt clay, wet sand and dense gravel-till, "N" ≥ 85 to 100**.
4	13	10" x 10" @ 57 lb/ft, steel H-section	30	(9.1)	143	(1272) ***	60	(534)	Driven into buff till to refusal in very dense limestone rock fragments.

* Critical in the use of treated timber piles is the possibility of causing damage due to over-driving. Pictures on overleaf provide stark evidence of this fact. For Site No. 2582, the analysis of the test load results indicated that pressure developed in the shale was in the order of 313 kips/ft^2 or 2,175 lb/in^2 (15 MPa) compared to 4,830 lb/in^2 (33.3 MPa) given as the proportional limit for "Douglas Fir" timber in compression parallel to grain.

** The pressure below the tip of the pile was in the order of 373 kips/ft^2 (17.9 MPa). "N" is the value obtained from the standard "split-spoon" dynamic penetration test; an *in situ* test.

*** The ultimate load given is estimated in that the test pile was not loaded to achieve progressive failure; something that in all likelihood would not have been practically possible. It is almost certain that a higher allowable load could have been used if the pile could have been loaded to obtain ultimate failure.

The pictures (above and below) are examples of the damage caused by over-driving of timber piles which occurred during the construction of the bridge over Wavy Creek, on P.T.H. No. 8, E. of N. E. ¼ Sec. 1-15-3 E., R.M. of St. Andrews, Site No. 1120.

Review of the pile driving records indicate that a knowledgeable engineer should have recognized that the piling was stopping on top of the limestone bedrock. Drilling investigation would have indicated at what depth to expect driving refusal. Notwithstanding the damage to the timber piles, the foundation support was adequate for the life of the bridge even though it was subjected to heavier loads than it was designed to support. The bridge was built in 1957 and was replaced in 1989 because it had become hydraulically and geometrically inadequate.

The pictures (above and below) show a typical heaving of treated timber pile bents. The expansion of the freezing river bed causing the lifting of the piles was a major design problem, not easily prevented in practice. Very rarely does this type of foundation fail by settlement due to truck overloads and this demonstrates how friction forces act on the pile shaft to support additional live load reactions. Even after the frost comes out of the ground during the summer, the bent will not settle back down under the weight of the heavy truck axle loads.

Economics of Short Span Bridges

So that the following comments will not be misinterpreted, a general description of a short span bridge is given. A short span bridge is considered to be any structure in which no portion of the superstructure spans more than, say 200 ft (61 m). The selection of the type of bridge to be used involves the possibility of saving or wasting more money than any other engineering design decision that will be made. It is however, the most difficult and yet the most important aspect of the bridge designer's duties from start to finish. The correct selection of not only bridge type but the materials to be used is the very key to the construction of a short span bridge at least cost to the taxpayer. The following are some of the controlling factors which influence the cost:

1. Availability of standard types of girders
2. Site conditions; topography and sub soils
3. Type of abutments used
4. Geographical location and access to the site
5. Clear span length.

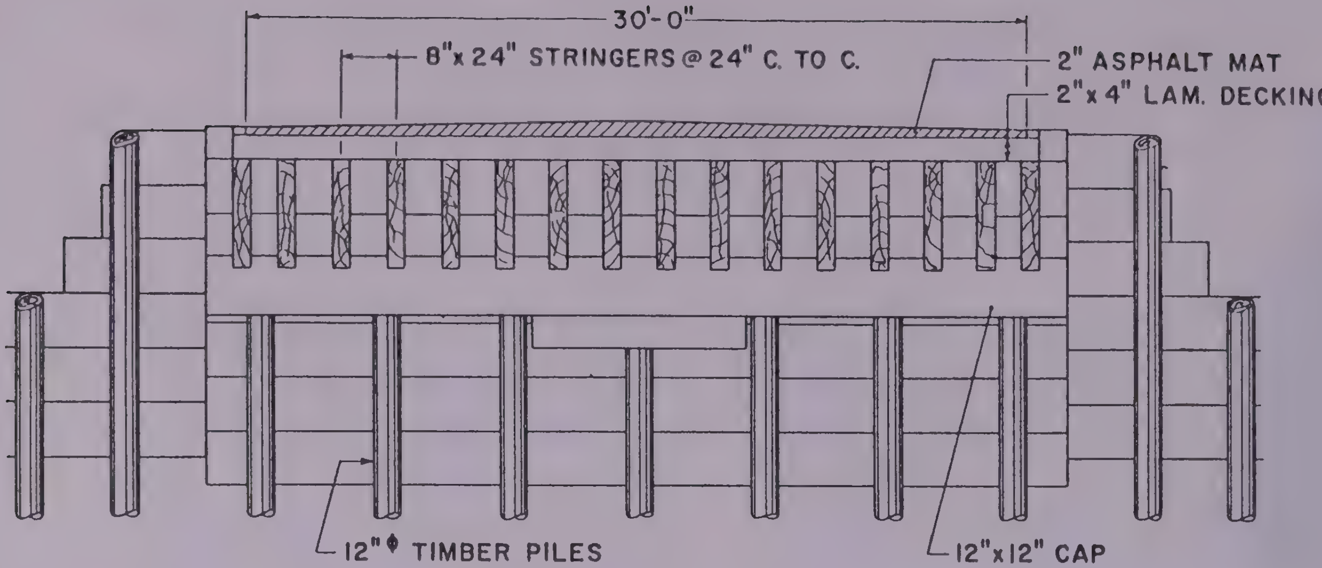
It can be said without fear of contradiction, that the shorter the distance between supports, the more economical the bridge superstructure providing that the cost of the substructure can be proportionately reduced.

The economics of bridges are rather complex and no exact formulae are available to satisfy all the variables influencing these costs. The reason for this is probably best answered in the following statement by Dr. J.A.L. Waddell, when he wrote in his book on "Bridge Engineering" that "from the purchaser's point of view that structure is the most economic which will do the work required of it for as long a time as necessary, with the least possible expenditure for operation, maintenance, and repairs, all these desiderata being obtained with the smallest practicable initial cost of construction." Many things have changed since Dr. Waddell published his volumes on bridge engineering, but his definition of a most economical structure will always be valid.

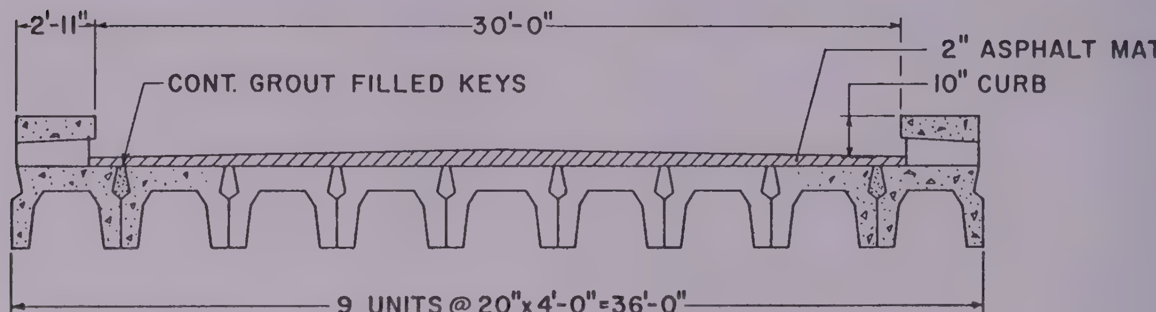
Several factors play a very important role in keeping the costs of short span bridges to a minimum. These are: first, the correct interpretation of the soil log boring and the hydrological and topographical survey information; secondly, the selection of type and thirdly, standardization of bridge girders and beams to permit volume manufacturing of the same.

Figures 4 and 5 on pages 90 and 91 illustrate typical cross-sections of short span bridges. It is evident that the spacing of girders increases with the density of the material employed. Similarly, the quantity of the girder material should be kept to a minimum if an economical design is to be achieved. Therefore, with increasing span length the spacing of girders must increase and the cost of the deck system will be proportionately increased.

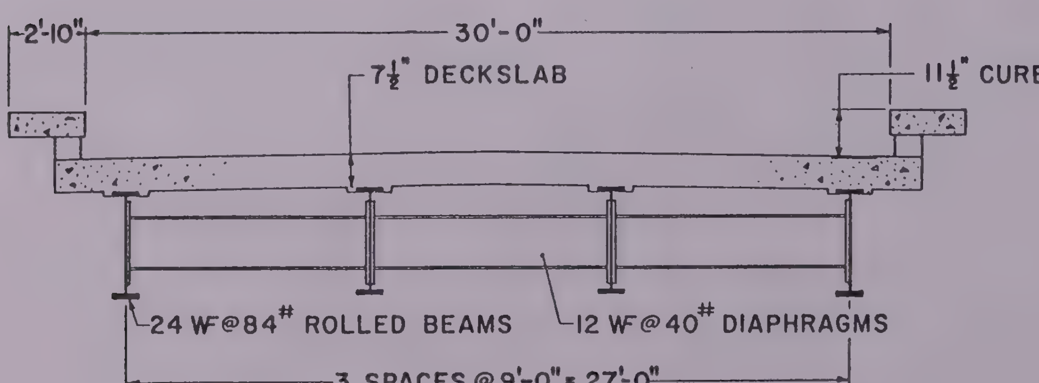
Generally speaking, a high retaining wall type of abutment should not be used; it is not only an expensive solution but creates end slope stability and consolidation problems at the end of the bridge behind the retaining walls. Even though approach slabs are built, supported on the top of the backwall of the abutment, settlement of the approach roads will persist. Consequently, a longer bridge will be a more economical solution, by building more approach spans across a flatter slope with a smaller shelf type of abutment supported on piles. Pictorial examples of some standard types of short span bridges can be found on pages 92 to 95 inclusive.



TIMBER 33'-0" SPAN

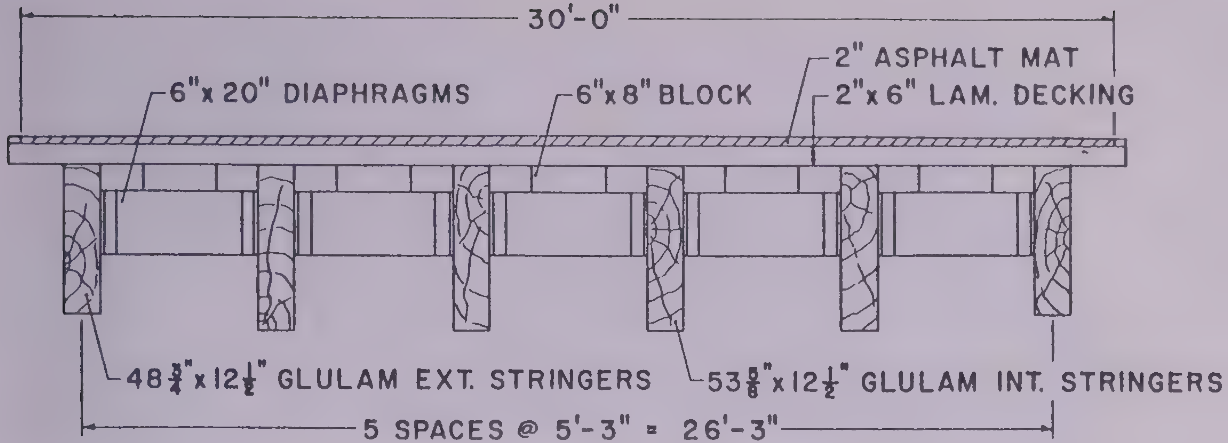


PRECAST PRESTRESSED CONCR. DECK UNITS 33'-0" SPAN

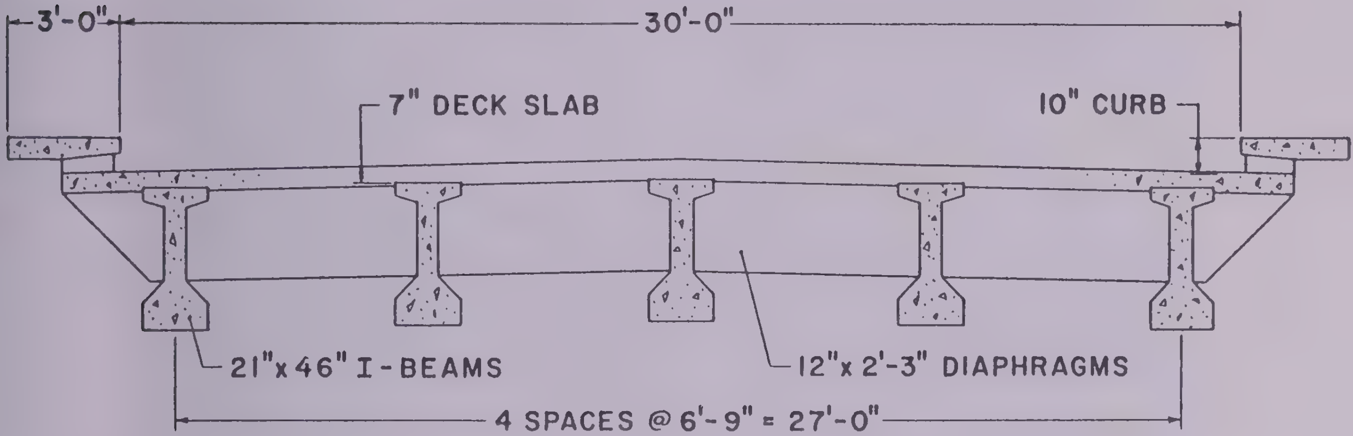


STRUCT. STEEL GIRDERS ϕ CONCR. DECK 30'-0" SPAN

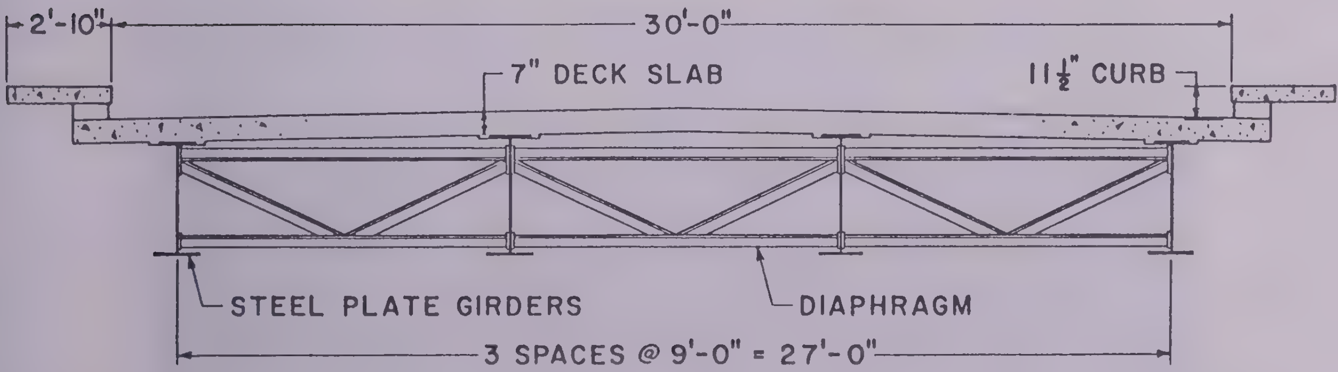
FIG. 4 - TYPICAL CROSS SECTIONS
BRIDGE SPANS 20-40 FEET



TIMBER 70'-0" SPAN



PRECAST PRESTRESSED CONCR. BEAMS 67'-6" SPAN



STRUCT. STEEL GIRDERS & CONCR. DECK 67'-6" SPAN

FIG.5 – TYPICAL CROSS SECTIONS
BRIDGE SPANS 50-80 FEET

The pictures described below and on the following page are included to show examples of bridges built to the details found on Plates No. 8, 9, 10, 11, and 12, pp. 126-135. Each picture shows a different arrangement of spans using the economical and easily constructed treated timber (T.T.) standard superstructure on top of various types of substructures:

1. A two span 67 ft 6 in (20.57 m) treated timber bridge with a concrete steel pile bent for the pier, located on P.T.H. No.45 over the Oak River, Site No. 612.

2. A three span T.T. bridge on treated timber pile bents having an overall length of 64 ft 8 in (19.71 m) located on P.R. No. 274, south west of Ethelbert over the Fishing River, Site No. 3713.

3. A structure with seven 33 ft (10.06 m) long T.T. spans on steel "H" pile bents with reinforced concrete caps and treated timber pile abutments. The bridge is 232 ft 6 in (70.87 m) long with a clear vehicular roadway width of 30 ft (9.14 m). It is located on P.T.H. No. 31 over the Pembina River, in S.W. ¼ Sec. 4-2-7 W., R. M. of Pembina, Site No. 2419.

4. A three span T.T. bridge on T.T. pile bents made up of two 21 ft (6.40 m) and one 33 ft (10.06 m) standard spans for an overall length of 76 ft 6 in (23.32 m) with a clear vehicular roadway width of 30 ft (9.14 m). It is located over the Whitemud River on P.R. No. 258, Site No. 2430.

These treated timber standards were conceived and developed in the late 1940's under the supervision of Messrs. James and Lamb mentioned earlier. Mr. M. P. Anderson was the inventor of the ideas used in the preparation of the standards' details.

See bridge office staff picture, 1950, on page 6.

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In the late 1950's the bridge design office embarked on the development of a set of standard prestressed precast concrete channel beams and I-girders for use in the reconstruction of the major provincial highway bridges. At the same time the benefits of using reinforced concrete box culverts was realized and some of these were used to replace the old timber bridges to cross smaller creeks and rivers. Pictures (below and facing page) of some typical bridges using these standard superstructures have been included to illustrate the evolution of the bridge design in the province over the years.

1. The reinforced concrete bridge over the Fishing River located on P.T.H. No. 20 is 77 ft 3 in (23.55 m) long and provides a vehicular roadway width of 30 ft (9.14 m). The superstructure is made up of two spans using pre stressed precast concrete channel girders. Site No. 110.

2. The bridge over Bear Creek on P.T.H. No. 44. This is the first bridge in the province where the new precast prestressed concrete channel was used. It is 34 ft 2 in (10.41 m) long and provides a vehicular roadway width of 38 ft (11.5 m), Site No. 3241.

3. The bridge over the Brokenhead River on P.T.H. No. 44. This is the first bridge in the province where the new precast prestressed concrete "I" girder was utilized. It is 137 ft 6 in (41.91 m) and provides a vehicular roadway width of 30 ft (9.14 m), Site No. 3239.

4. The bridge over Salt Creek on P.T.H. No. 10 and 5. It is 60 ft (18.29 m) long and 38 ft (11.58 m) wide. It was built using the longest standard precast pre stressed concrete channel in the series and it was the first channel deck to be sealed with an epoxy resin coat beneath the 2 in (51 mm) asphaltic concrete wearing surface, Site No.1710.

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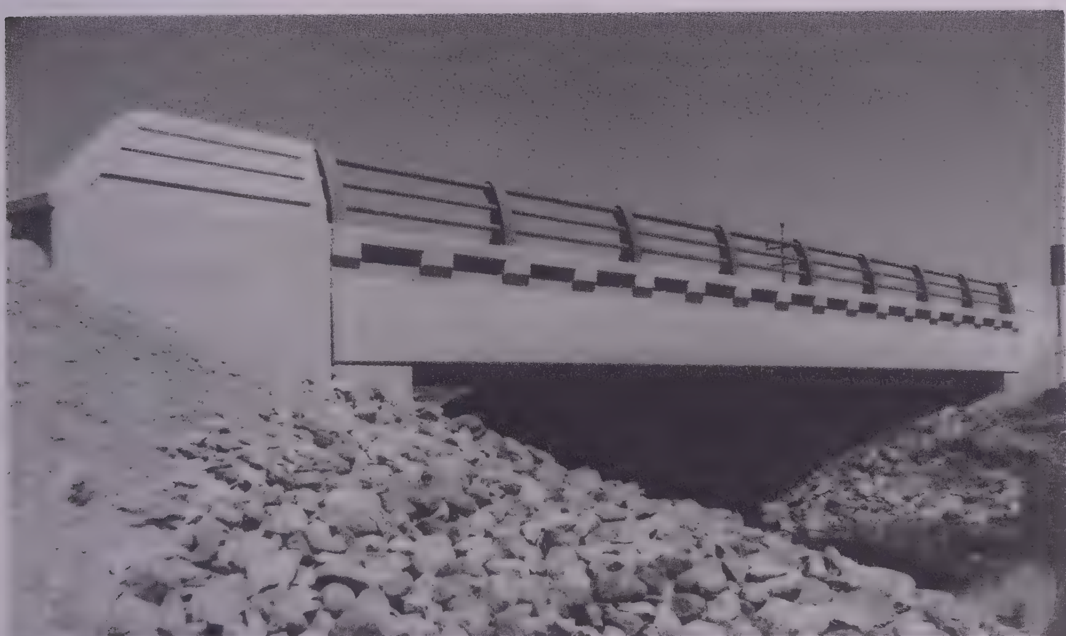

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3

The Profession

Ethics, Technology and the Engineer

The advent of the tremendous capacity to gather together information and knowledge to assist a professional engineer in carrying out his/her work makes the ethics of his/her approach to rationalize the situation and the design problem of paramount importance.

The design capacity available to the engineer, built into the electronic digital computer, through the storage of software for design, gives the young engineer a powerful tool with which he/she can manipulate the designs to obtain whatever answers he/she want to produce.

The big question then becomes the ethical objective of the registered professional engineer. How big a risk factor does he/she build into the design? Is the input data realistic? Does the common sense approach of the experienced engineer still have any validity? Must he/she now re-invent the wheel in order to use the powerful capacity of the computer and does the idealism of the new generation engineer replace the practicality of the past? Is the "sacred cow" of the economics in a business atmosphere which calls for "profit at any cost" or "time is money" to be held in higher esteem than the need to serve the consuming public with integrity ?

How do we understand the designer's selfhood? After spending the best years of his/her youth learning theoretical concepts and application skills to solve problems, has this person not earned the right to work in his/her chosen profession? How does the recent graduate gain experience, even if a job is found, manipulating machines into which the theoretical relationships between stresses and strains have been preprogrammed? The drafting computer aid robot will even eliminate the need to detail on paper. But who will be responsible for the adequacy of the design and the correctness of the plan details? Ultimately hands have to be put to work to build the bridge. Therefore the design details must be accurately communicated to the builders' workmen.

"A dialectical approach is necessary but this sets up conflicts which the psychic of the design person must resolve." (Quotation by Mark De Pauw, P. Eng.)

In 1920 engineers in Manitoba decided they should have an Association to give guidance to the practising engineer and at the same time provide an opportunity for fellowship with his/her peers. They probably wanted to achieve some public recognition , promote self interest and provide a forum for mutual exchange of ideas as well as to encourage the government of the day to enact legislation for the protection of the public.

Mr. W. M. Scott was appointed provisional President until the permanent President and Council could be elected. An Act to incorporate "The Association of Professional Engineers of the Province of Manitoba" was assented to on March 27, 1920. A partial copy of this document, which lists the members, has been reproduced in Appendix 1. The Association's Code of Ethics adopted November 1, 1921 reads in part as follows:

"The following rules are a general guide to conduct and are not intended to deny the existence of other duties equally important though not specifically mentioned.

The Council is empowered to enforce the rules herein established, but it is the privilege of any member to consult the Council as to the proper conduct to pursue in any specific case.

Code of Ethics

To the State

1. The Professional Engineer owes a duty to the State, to maintain its integrity and its laws, and not to aid, counsel or assist any person to act in any way contrary to its laws.

2. When engaged as an expert witness he shall at all times act with candour and fairness, and give, to the best of his knowledge and ability, an honest opinion based on adequate study of the matter in hand.

To His Client

3. He shall act in all professional matters strictly in a fiduciary manner with regard to any clients whom he may advise and his charges to such clients shall constitute his only remuneration in connection with such work, except as provided by Clause 6.

4. etc.

To His Fellow Engineer

9. He shall not attempt to injure, directly or indirectly, the reputation, prospects or business of a fellow Engineer.

10. He shall etc.

15. A breach of any of the foregoing Rules of Conduct by any member of this Association shall be considered inconsistent with honourable and dignified deportment in his professional practice, and such a member may be deemed guilty of unprofessional conduct, and hereby subject to discipline under Section 19, sub-section 1, of the Engineering Profession Act."

The 1921 text of the Code can be found in Appendix 10, p. 259.

The essential elements of the Professional Act and the Code have not changed significantly over the years and the Association has restated the main theme again and again, this being that "Honesty, justice and courtesy form a moral philosophy which mutual interest among men, constitute the foundation of ethics." The rewritten and adopted Code of Ethics, dated February 28, 1968, states that integrity is the keystone of the profession. This means that a professional engineer must be totally honest and should never tolerate half truths. This may seem to be very straight forward to the average individual, but in practice very difficult to achieve, especially, if your boss is a politician. Many of the pioneering engineers who started us on our professional way were practising bridge design engineers. They have been identified in earlier

chapters of this book. Their vision must certainly have been to contribute to the ability of their successors to better serve the public as our province developed.

An important requirement of the Engineering Profession Act was that "Every person registered under this Act shall have a seal, the impression of which shall contain the name of the engineer and the words "Registered Engineer, Province of Manitoba," with which he shall stamp all official documents and plans." The foregoing is the 1920 version, and in intent does not differ from the most recent 1985 Act which reads as follows:

Individual Seal.
"19(1) Every member upon being first registered under this Act shall be issued a seal, the impression of which shall contain the name of the member and the words "Registered Professional Engineer, Province of Manitoba" or "Ingenieur inscrit, Province du Manitoba" and the member shall make an impression of the seal on every estimate, specification, report, working drawing, plan or other document issued under his hand."

In March, 1987 the Association of Professional Engineers of the Province of Manitoba (APEM) published guidelines regarding "The ethical use of the engineering seal". Unfortunately, the guidelines do not contribute to the use of the seal as a means towards the better serving of the public. Section 4.1.3 entitled "Use of "P. Eng." as an Alternative", provides a loop hole for those managerial engineering types, who hold key positions of authority and influence, to avoid the acceptance of responsibility.

Too often such registered engineers, who gained their highly responsible position because they were P. Eng., will slant the interpretation of a technical report to satisfy the wishes of their political masters. While the document or letter may not contain "substantive technical data" the deliberate misinterpretation or unwitting misreading of the conclusion of an "Engineering" report can have major consequences with regard to the welfare and the protection of the public. Therefore, the use of the seal must be "to record and communicate an acceptance of responsibility for the quality and the accuracy of the document to which it is affixed." The association should be very concerned that the use of the seal has not been deemed necessary in our courts to validate engineering documents.

A double standard has been and is being applied by the courts and legal advisors regarding the use of the seal in Manitoba and APEM should be willing to go to the highest courts of our land, if necessary, to uphold the requirement of its use as per the Engineering Act.

For example would it not be considered highly unethical and in violation of the professional engineer's duty to place the safety of the public above all else; if say, a Registered P. Eng. in the top civil service position wrote a Minister of the Crown as follows - "I also have some concerns that once our staff becomes involved in this project, their professional ethics will require they ensure that any work that is recommended by them or supervised by them will have to meet standards which may result in additional costs which the L.G.D., (Local Government District) may feel unnecessary. If we could limit our involvement to some

preliminary survey work and staking to assist the L.G.D., we might overcome this problem, but I am afraid that if we get staff involved in engineering and supervision of construction, this could lead to other problems as the L.G.D. gets further into this project." A bridge built under such an unprofessional atmosphere failed shortly after its construction and subsequently the professional engineering staff was required to evaluate the problem and recommend a solution. An other example was the premature washout of a large corrugated steel arch culvert which had replaced a larger reinforced concrete bridge that had withstood many floods over its life span. In this case the registered professional sales engineer placed the desire to make a sale to a public authority ahead of the protection of the public. The excuse was that the Municipality involved did not have sufficient funds in the budget to install adequate hydraulic capacity. How fortunate that no one drove into the flooding and swollen river during the night; before the washout was discovered. This situation was reported in writing to the APEM. However, the council of the day seemed unwilling to or felt unable to bring the professional engineer responsible for the work to task. Why? Would the pioneers of our profession be embarrassed or disappointed with our failure to act? Yes, the "whistle-blowers" will face retaliation for their courage in identifying unsafe practice dictated by their employer. In the future these situations will not arise too often because of a more open public scrutiny and improved business ethics. The practice of profit over all else will gradually change because it may be ultimately construed as poor business practice in the long run.

An other serious dilemma facing the Chief Bridge Engineers of the Highway Departments is the ever increasing size and weight of trucks permitted to use the road system, brought about by the continuing lobbying of the trucking industry. The politician has not had the courage to say no, even though engineering reports persistently recommended against the allowing of heavier and larger vehicle loads. The magnitude of the problem was illustrated in the previous chapter of this book. The solution to resolving these dilemmas lies in the discharging of one's professional engineering duty to the public, a challenge handed down to us by the pioneers and the Association's willingness to protect the whistle-blowers' careers. Society stands to gain enormously if courageous registered professional engineers risk their careers when necessary in the name of public safety. We cannot afford to be without them.

Notwithstanding the foregoing comments, in the process of researching material for this book, it became evident that our pioneers did not systematically apply the "Professional Engineering Seal" to the plans prepared under their supervision and design. Only two of the "Plates" display a "seal". Does this mean that they did not execute their task in a competent and ethical manner? Their works still in place, are evidence of their "professionalism". Therefore, it might be concluded that true professionalism lies in the "soul" of the person, and cannot be legislated by others. We could conclude that the protection of the public lies in the employing of the person who has voluntarily chosen to be a "registered professional engineer" and in maintaining his membership, has publicly stated his intention to do his/her work in accordance with the association's "Code of Ethics".

Professionalism - What is a Profession?

At a seminar sponsored by the Association of Professional Engineers of the Province of Manitoba, David Ennis, P. Eng. and Executive Director of the Association, and formerly a bridge construction supervising engineer started deliberations of the day (February 16, 1990) by stating that "Historically the Professions have been three: Medicine, Law and the Priesthood. Professionals it seems looked after one's health, one's fortune and ones' soul...and that a profession requires:

1. Specialized knowledge

2. Long and intensive study and instruction

3. A knowledge of the historical or scientific principles underlying the instructions

4. High standards of achievement and conduct maintained by force of organization

5. A commitment to continued study

6. Work which renders as its prime purpose a public service

Mr. Ennis concluded his address by quoting the following passage from the Bible "and whoever forces thee to go for one mile, go with him two." (Matthew, Chapt. 5, vs. 41).

Most registered professional engineers are willing and capable of going the extra mile to better serve the client and thereby achieve the ultimate goal, the safety and protection of the public. Yet in the eyes of the public the practising design engineer has not gained recognition as a professional. At all these seminars, we the engineers find it convenient to refer to structural failures that resulted or bordered on imminent disaster and threatened the immediate safety of the user public.

However, there are many situations where the client (a person needing engineering advice) engages non-registered technical persons, whose main objective is to earn income and who will take advantage of the client's ignorance. The ability of the Association to enforce the act has been a serious stumbling block since its inception. The major difficulty has been in defining what is the practice of engineering. In the early pioneering days it was less critical than today to define the practice of engineering, because of the present availability of powerful analytical tools which make it possible for technicians and the technologists to turn out sophisticated designs without the knowledge and understanding of the theoretical principles involved. Therefore the chance of major inadequacies or grossly over designed facilities occurring must be of real concern to the registered professional engineer. Although safety is the bottom line, the economic benefit of the use of a qualified registered professional engineer is the real issue in most situations. Yet, why would an engineer "blow the whistle" and report a person (a non-engineer) to the authorities if he has knowledge that shoddy and overly expensive work is being performed? If he interferes he would likely be told to mind his own business and in the process lose some friends or make enemies out of his neighbours or open himself up to a possible lawsuit.

Another serious problem in Manitoba with respect to the definition of the practice of engineering in the statute is the unwillingness of the academics (professors) to have the teaching of engineering subjects listed as being the practice of Engineering. This results in the registered professional engineers teaching at the engineering schools of technology not being recognized as practising their profession.

During the past twenty years there has been a strong move to use of a technologist for design, replacing the engineer who, it was rationalized, should be engaged in more innovative work. There are some very serious problems associated with this move which already has been taking place in many areas. The most obvious is the resulting depression of salaries for both the young engineer and the technologist. But even a more serious problem is the limiting of the opportunity for an engineer to gain much needed experience in applying the scientific theories learned at the University. It is especially important because of the development of the computer. Computer software has already been developed which will design the most intricate bridge and will hook into a robot drafting tool so that the final plans will be produced with a minimum participation by a knowledgeable engineer, creating a potential for major errors to occur.

In the days when ideas about honesty have become dangerously elastic, our code of ethics must provide us with the guidance to help us determine the fundamental distinction between right and wrong human conduct. Not only must we be honest in the execution of our professional work but we must honestly communicate the results of our endeavors to the decision-makers. All too often the decision-makers are managers and sometimes politicians, who are also engineers. It is appropriate at this point to move away from the bridge design discipline and quote Samuel C. Florman, P.E. when he wrote about the fatal launch of the Challenger space craft in his article entitled Engineering Under Pressure - "In the heat of the moment, Challenger's managers forgot that they were engineers, too. It may have been a crucial error." Enforcement of the Engineering Profession Act is complicated by the immense diversity of the engineering disciplines. In practice a more realistic position to take would be that work done by Registered Professional Engineers is the practice of Engineering, otherwise it is not. A renowned Canadian Engineer, Mr. Carson Templeton speaking at the November, 1989 seminar on "Engineering Ethics and the Environment" suggested that it is the very greed of men that is the biggest stumbling block to resolving the potential destruction of the environment. He made three succinct points. These were the following:

1. Self interest dominating the decision making process even in a "Systems Engineering Approach".

2. Non-compliance with the statutes and supporting regulations by large companies because of the over-riding profit motive.

3. Administrative conflicts between government jurisdiction.

The above again brings out the tremendous importance of adhering to the dominant principle of science: insistence upon truth. And in conclusion, it is suitable to revert to quoting from the Bible "And the rain fell, and the floods came, and the winds blew and beat against the house [bridge] , but it did not fall, because it was founded on rock. And everyone who hears these my words and does not act upon them, shall be likened to a foolish man who built his house on sand. And the rain fell, and the floods came, and winds blew and beat against the house [bridge], and it fell and was utterly ruined." Matthew Chapter 7, verses 25 to 27 inclusive. Are we Martha's sons?

Professional Unions

Traditionally, the Engineering Associations have discouraged and even actively opposed the formation of professional engineering unions or even self interest groups. The rationale behind this opposition is that such organizations would violate the idea that we exist solely for the protection of the public. But who is the public to be protected from? The registered Professional Engineers who by their membership undertook to abide by the Association's code of ethics? It can be argued that actually an association of engineers in similar disciplines, such as, structural design would work towards the enhancement of the protection and safety of the public. Membership in such a labour union organized under the labour relations act would certainly be restricted to the highly qualified and skilled practitioners in this specialized field of engineering.

Bridge Engineering is a highly specialized engineering field involving at least three special disciplines. These are structural, geophysical (soil mechanics), and hydrology including hydraulics. A strong union of such a group of engineering practitioners would surely increase the awareness of the public to the value of engaging one of their number to design the bridges for their use. We see medical doctors engaging in strike action or issuing the threat to take strike action through their association; why not engineers? During the past decade there has been a steady campaign by the engineering community and the politicians to promote continuing education. At the same time there is a serious concern regarding the ever increasing cost and drain of the public purse to subsidize higher education. If these proponents of higher education had more than the corner of their eye on the truth, they would recognize that the solution is to pay better wages to those engineering specialists who are doing the actual engineering design: a continuing engineering educational process in itself, and thereby eliminate duplication of the educational effort.

If the practice of engineering is ever to reach the professional plateau we will require as a minimum a diploma from a technical college to qualify for university entrance. Those, and only those, who are willing to go the "extra mile" would be recognized as professional. Furthermore, their union would see to it that these selected few are adequately remunerated to encourage them to remain in their chosen careers, and not try to move into the field of management to gain a respectable living wage. A saying among engineers recently is that one should get out of the designing engineer's role as quickly as possible if one wants to get ahead and improve one's image in society and enhance one's income or earning capacity. The public would be better served if we took steps to keep the highly qualified engineering engineers in design and research by paying them at the level of the general managerial types. After all, they are the surgeons and the skilled specialists who must not make mistakes if the public is to be kept safe from harm.

List of Drawings
(Plan Details)

Plate No. 10,	Assembly Details for a Treated Timber Bridge, St'd. T.S. 309, Dept. of P.W. Highways Branch, 1956, Plan No. 2885.
Plate No. 11,	Framing Details for a Treated Timber Bridge, St'd. T.S. 301, Dept. of P.W. Highways Branch, 1957, Plan No, 2885.
Plate No. 12,	43 ft 6 in Treated Timber Pile Bridge St'd. T.S. 314, Dept. of Public Works Highways Branch, 1957, Plan No. 2885.
Plate No. 13 (a),	Precast Prestressed Concrete I-Beam St'd. P.P. 100 B, 90 ft 0 in Span Dept. of Public Work, Highways Branch
Plate No. 13 (b),	General Elevation for Bridge over the Red River Floodway, P.T.H. No. 44., Dept. of Public Works, Highways, 1962.
Plate No. 13 (c),	Log Boring Details for Bridge over the Red River Floodway, P.T.H. No. 4E. Dept. of Public Works, Plan No.4
Plate No. 13 (d),	Pile Layout for Bridge over the Red River Floodway, P.T.H. No.4E. Dept. of Public Works, Plan No.4
Plate No. 14,	Assembly Details for a Precast, Prestressed Concrete Channel, St,d. P.C. 100, Jan.7,1988
Plate No. 15,	81 ft Howe Truss Bridge over the Roseau River N. of Sec. 35-1-6 E., Mun. of Stuartburn, Dept. of Public Works, March, 1918. Plan No. 381.

Plate No. 16 (a),	24 ft Reinforced Concrete Bridge located in Sec. 34-2-17 W., R.M. of Turtle Mountain; Dept. of Public Works, Good Roads Board, Built April, 1927, Plan No. 1337.
Plate No. 16 (b),	Reinf. Concrete Bridge located N. of Sec. 35-3-27 W., R. M. of Arthur, Department of Public Works Good Roads Board, Jan. 1927, Plan No. 1350.
Plate No. 17 (a),	Treated Timber Bridge over the Fisher River, in Sec. 14-28-1W., Unorganized Territory, Dept. of Public Works, Built in Dec. 1944, Plan No. 2474.
Plate No. 17 (b),	Member details of the bridge above.
Plate No. 18,	116 ft 6 in T.T. Bridge over the Whitemouth River; Mun. of Birch River (Disorganized), N.E. of Lot 8, Twp. 9, Rge. 12 E., July, 1947, Plan No. 2517.
Plate No. 19,	Elevation and Plan of a 352 ft 10 in long Reinforced Concrete Bridge over the Assiniboine River Diversion Parish of St. Francois Xavier, in Lots 199 & 200, R.M. of St. Francois Xavier; Nov. 1953, Plan No. 2594.
Plate No. 20 (a),	Planka Plains Bridge over the Roseau River, located E. of Sec. 3-3-5 E., R.M. of Franklin, P.T.H. No, 59 Built in Sept. 1956; Plan No. 2397
Plate No. 20 (b),	Final Print for Fabrication & Erection of the above, Dwg. No. 15515-1, Plan No. 2397.

Plate No. 21 (a),	Plan and Elevation of the Bridge over the Sasagiu Rapids on the Wabowden-Thompson Rd. at Mile 17.7 Twp. 71, Rge. 7 W., E.D. of Churchill Built in July, 1960; Plan No. 3067.
Plate No. 21 (b),	Bearing Assembly Details for the Bridge listed above.
Plate No. 22 (a),	General Elevation for 67 ft 1 in, T.T. & R.C. Bridge over the Cypress Rv. E. of Sec. 5-6-11 W., R.M. of Lorne, Built in January, 1960. Plan No. 3075
Plate No. 22 (b),	Assembly Details for the above.
Plate No. 23 (a),	Two 75 ft Steel Spans over the Whitemouth River in S.E. ¼ Sec. 15-12-11 E., Mun. of Whitemouth, Dept. of Public Works, Good Roads Board, Dec., 1927. Plan No. 1470
Plate No. 23 (b),	R. C. Pile Abutments for the above.
Plate No. 24,	Reinforced Concrete Arch over the Whitemud River in Sec. 31-14-13 W. Mun. of Lansdowne & Langford, Dept. of Public Works, March, 1916. Highway Commissioner's Office, Plan No. 111.
Plate No. 25 (a),	Reinforced Concrete Bridge over the Souris River, E. 5-3-16 W., R. M. of South Cypress, Dept. of Public Works, Built May, 1920. Plan No. 412.
Plate No. 25 (b),	Sheet No. 1 of 6 for the above, showing concrete details.

Plate No. 25 (c),	General Elevation for repairs of the above noted bridge after the 1976 flood.
Plate No. 26 (a),	R. C. Deck Girder Bridge over the Souris River E. of N.E. ¼ Sec. 17-6-23 W., Mun. of Cameron, Dept. of Public Works, Built September, 1925. Plan No. 1151.
Plate No. 26 (b),	General Elevation for the reconstruction of the above bridge in June, 1979.
Plate No. 26 (c),	Plan and Profile of the above site as it was in May, June, 1979.
Plate No. 26 (d),	Pier Caps for SU.3 & SU.4 and concrete details for the above Plan No. 1151.
Plate No. 27 (a),	General Elevation for a 345 ft 0 in long Prestressed Concrete Bridge over Plum River on P.T.H. 75. in Lot 241, Parish of Ste. Agathe, R.M. of Montcalm. Built May, 1967. Plan No. 2542.
Plate No. 27 (b),	Log Boring Details for the above.
Plate No. 27 (c),	Reinforced Concrete Details for the above bridge, Plan No. 2542.
Plate No. 27 (d),	Assembly Details for the above.
Plate No. 28 (a),	General Layout for a Bridge over the Churchill River in Sec. 31-86-16 W., Built in 1969, Plan No. 3329, for Province of Manitoba.
Plate No. 28 (b),	Piers for the above Plan No. 3329.

Plate No. 29,	Plan of Lens Bridge over Swan River North of Sec. 34 Tp. 38 Rge. 25 W. Mun. of Minitonas & Unorganized. Reclamation Branch, Dept. of Public Works, 1935, Plan No. 2528.
Plate No. 30,	Std. 170 ft Highway Span, Steel Truss, over the Assiniboine River in the Municipality of Woodworth, Erection Diagram, Dominion Br. Co. Ltd., Dwg. No. El. Built in 1925, Site No. 7451,(Plan).
Plate No. 31 (a),	General Plan, Red River Bridge, Selkirk, Manitoba. Public Works, Canada. Plan No.352, Sheet 1 of 10. Oct., 1934.
Plate No. 31 (b),	Borings Plan, Sheet 1 of 10, Plan No. 352. Site No. 2431, Dept. of Highways and Transportation.
Plate No. 32 (a),	General Diagram for a Bridge over the Assiniboine River at Shellmouth, Man. N. of N.E. Sec. 30-22-29 W., Rural Mun. of Shellmouth, Public Works, Canada, Plan No. 224. Sheet No. 1, Built in 1906, Highways Site No. 7653.
Plate No. 32 (b),	Drawing of proposed Piers and Abutments for the above Plan No. 224.
Plate No. 33,	Souris River Basin, Map of the Study Area.
Plate No. 34,	A collage of the General Layout of the St. James Bridge over the Assiniboine River between the Municipality of St. James and the City of Winnipeg, Dept. of Public Works, Good Roads Board Plan No. 2264. Built in 1935.

Plate No. 35 (a),	General Drawing of the Assiniboine River Bridge in the City of Brandon, on 18 Street. (P.T.H. No. 10) Plan No. 3001. Built in 1959-60.
Plate No. 35 (b),	Steelwork Erection Details for above.
Plate No. 35 (c),	Deck Deflection Curves for the above
Plate No. 36,	A collage and General Plan of the bridge crossing the Red River on Provencher Ave. between the City of Winnipeg and the City of Ste. Boniface. Highway Dept. Plan No. 9009, December 15, 1912.
Plate No. 37 (a),	An Elevation Photo of the Bridge over the Red River on P.T.H. No. 4, north of Selkirk, Man. Dept. of Highways and Transportation, Plan No. 1662. Built in 1985-86.
Plate No. 37 (b),	Main River Pier Details, "Tremie Placed Concrete".
Plate No. 37 (c),	General Arrangement, River Crossing Spans.
Plate No. 38,	First Street Assiniboine River X-ing and C.P.R. Railway X-ing in the City of Brandon. Sheet No. D-7, Dept. of Public Works, Highways Branch Plan No. 2582. Built in 1908.
Plate No. 39,	A drawing showing "Truck Configurations" as prepared by Lorne Lautens, P. Eng. Chief Bridge Design Engineer for the Dept. of Highways and Transportation Province of Manitoba, April, 1989.
Plate No. 40,	Details of the "Drop Hammer and Attachments" for the Standard Penetration Test using the split-spoon sampler in soil density investigation work.

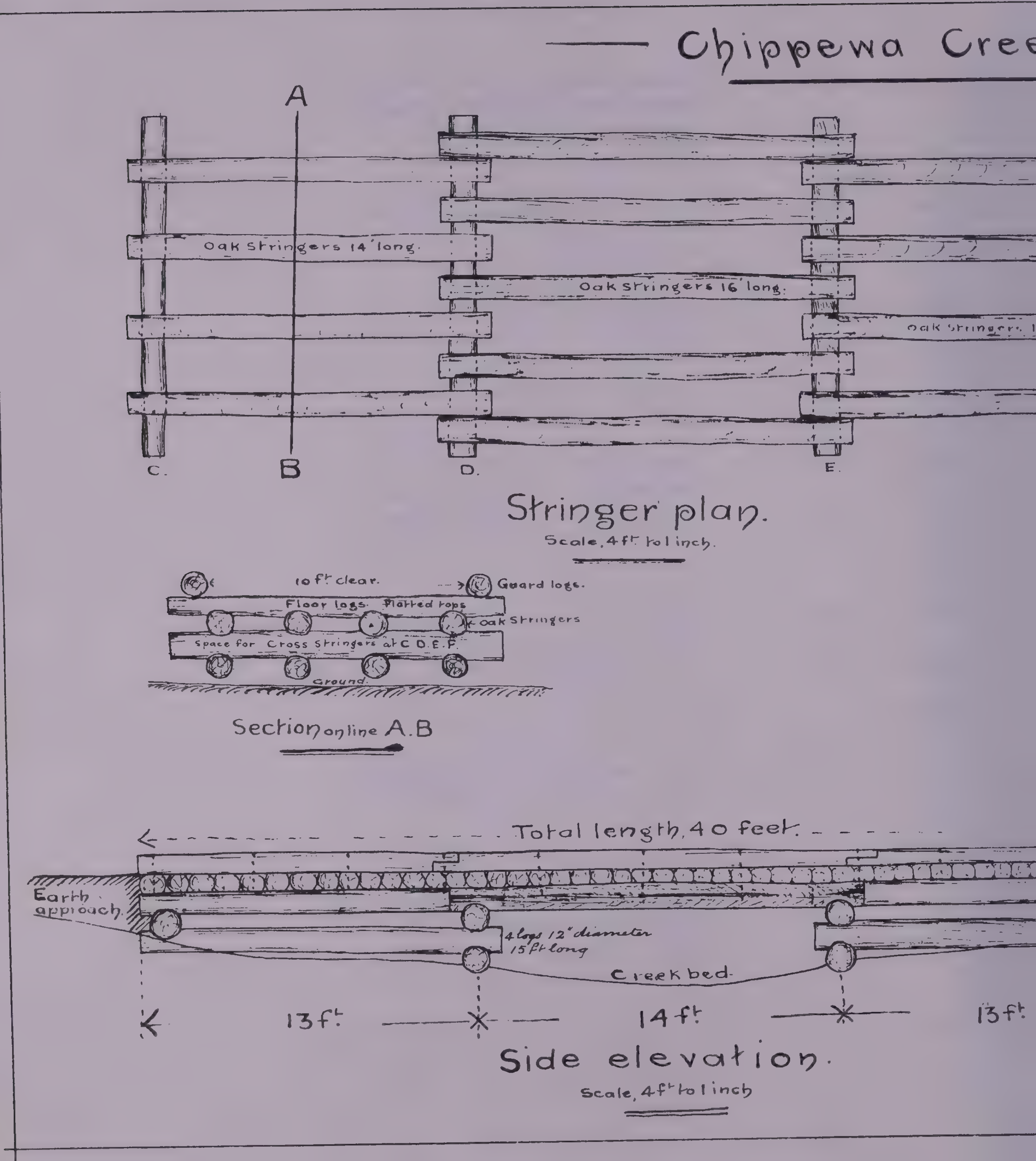

Chippewa Cree
A
B
C.
D.
E.
Oak Stringers 14' long.
Oak Stringers 16' long.
Stringer plan.
Scale, 4 ft. to 1 inch.
10 ft. clear.
Guard logs.
Floor logs. Flatted tops
oak Stringers
Space for Cross Stringers at C D. E. F.
Ground.
Section on line A.B
Total length, 40 feet.
Earth approach.
4 logs 12" diameter 15 ft long
Creek bed.
13 ft.
14 ft.
13 ft.
Side elevation.
Scale, 4 ft. to 1 inch

PLATE No. 1

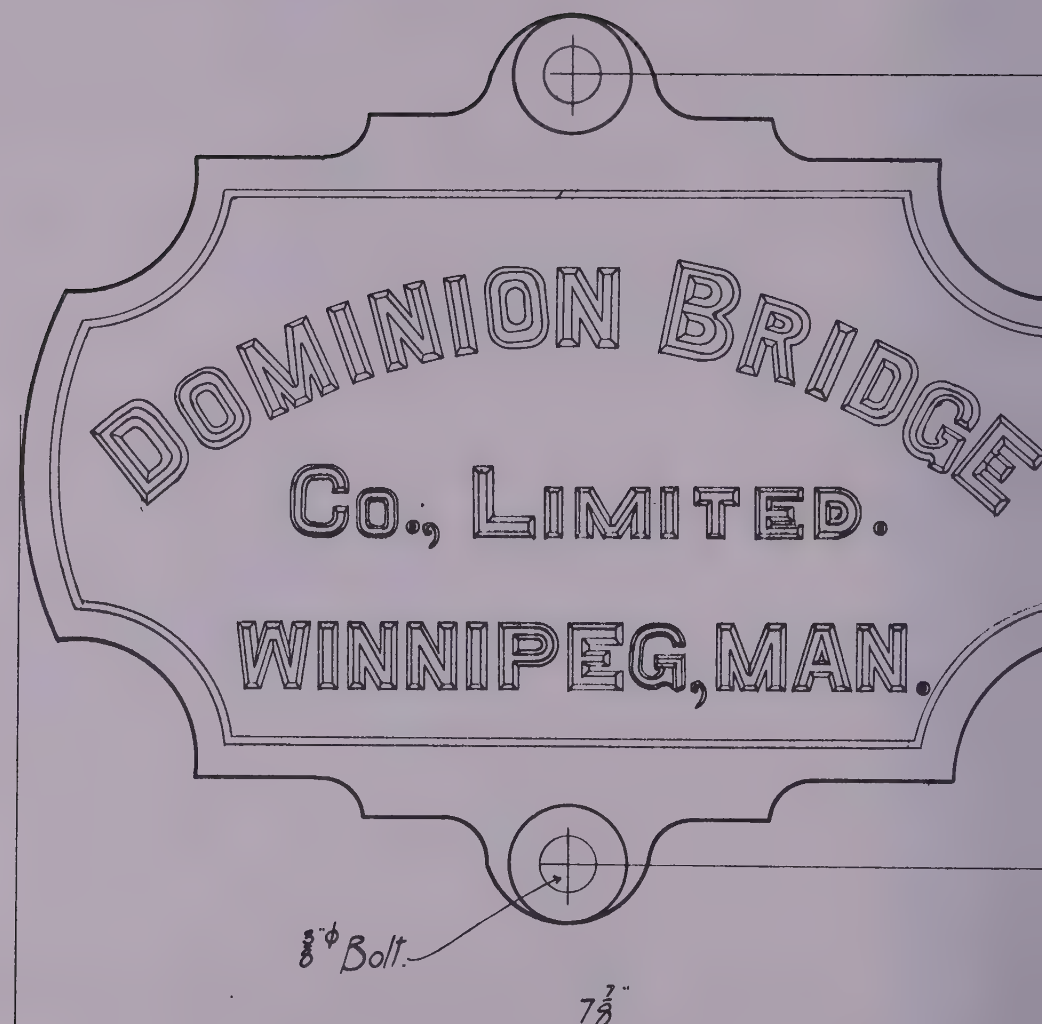
Bridge Plan and Specifications.

FAIRFORD COLONIZATION ROAD
LUNDYVILLE - MAN.

The old bridge to be moved, and material piled clear of the creek.
Cross stringers and under stringers to be of good white poplar, not less than 12 inches at butt.
The upper stringers to be of good sound live oak of the required lengths, not less than 9" diameter at small end.. The bark to be removed from all timber used before it is placed in position.
Guard logs to be spliced at joints and pinned to outside oak stringers on centre span, and to floor logs on outside spans not more than five feet apart with oak pins 1½ inch diameter.
Floor logs to be of good white poplar not less than 8 inches diameter, originally, to be flattened on top, close laid, and fitted to stringers on under side, and to be not less than 5" thick when laid -
Stringers to be laid with light saddle and rider joints. All stringers in both layers of end spans to be laid with butts towards the centre - The bridge is to be built in a straight line, taking the direction from end to end of present bridge
Any grading which may be necessary to complete the approaches to new bridge to be included in the contract price of bridge -
The plan must be adhered to. No claim for extras will be considered or allowed -
The work must be completed in accordance with the plan and specifications not later than September 24th 1898

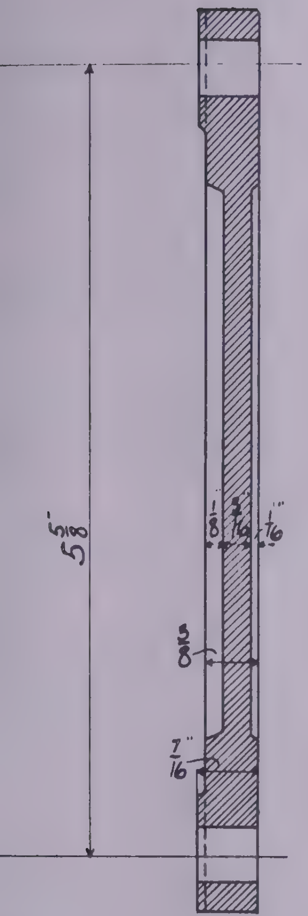
Chas. A. Gillican.
Acting Engineer

Department of Public Works.
Winnipeg, Sept. 24th 1898



8" Standard Name Plate.

Pattern No. 44

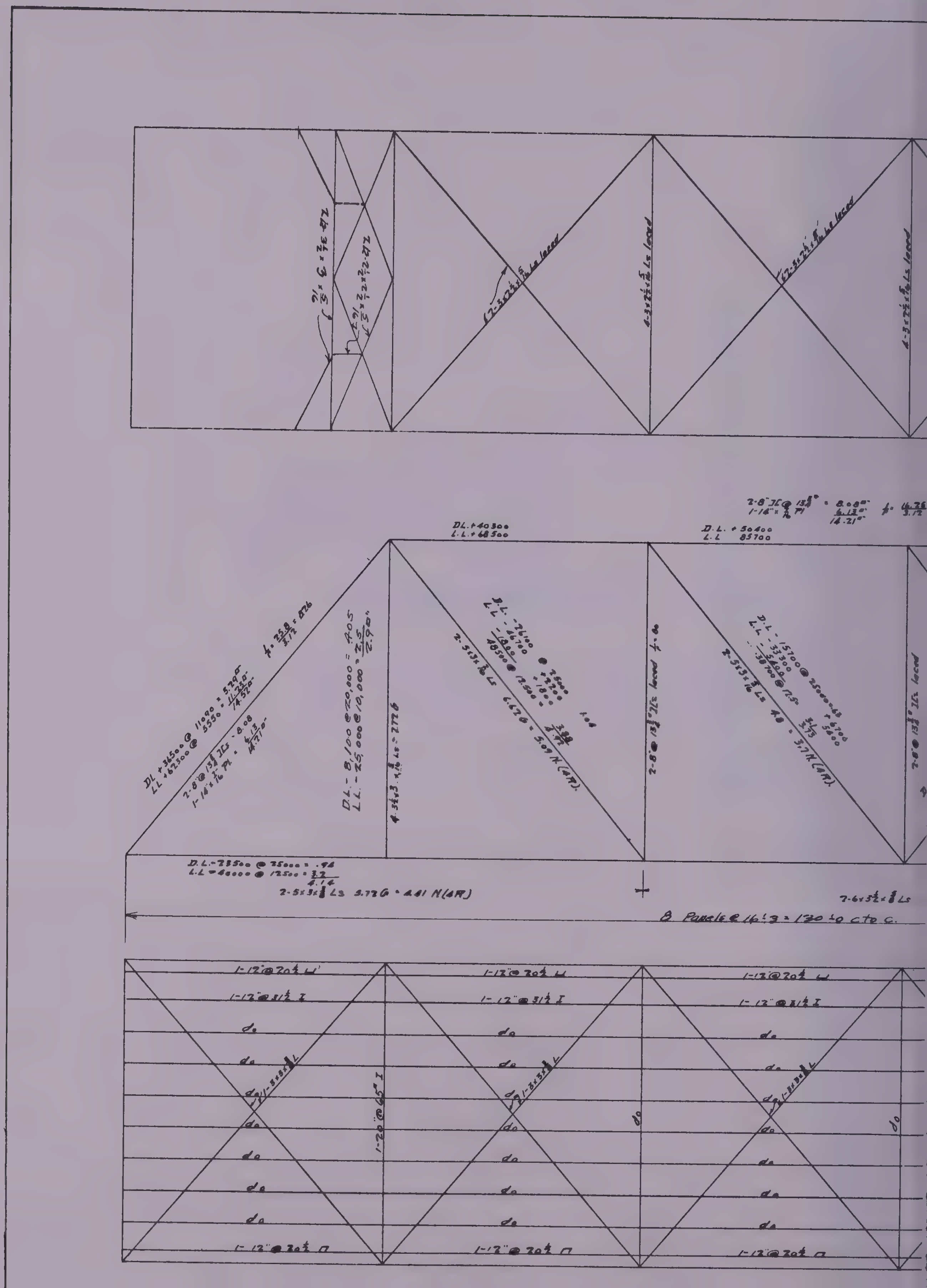


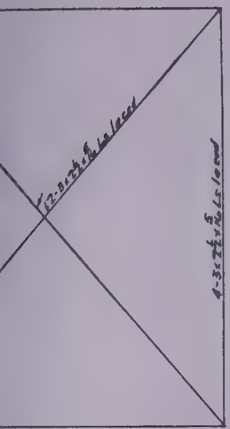
Two name plates are to be used for each highway bridge. These are to be placed on right side of entrance on end posts marked LoU1, about 6 feet vertically above bridge floor.
Name plates to be bolted on in shop.

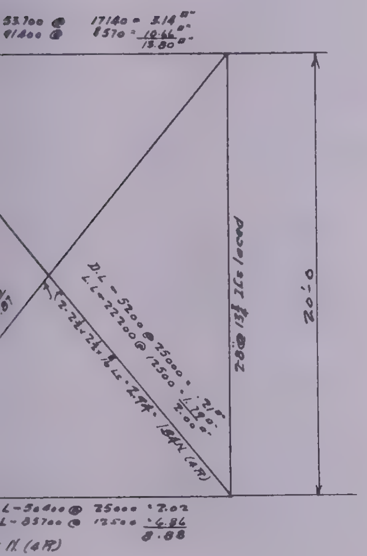
This name plate to be used on all spans under 100 ft.

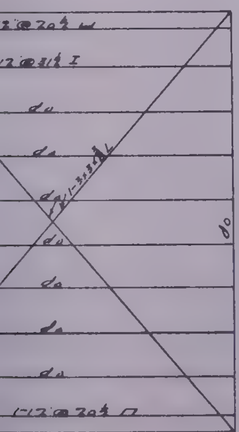
8th 13.

J.S.









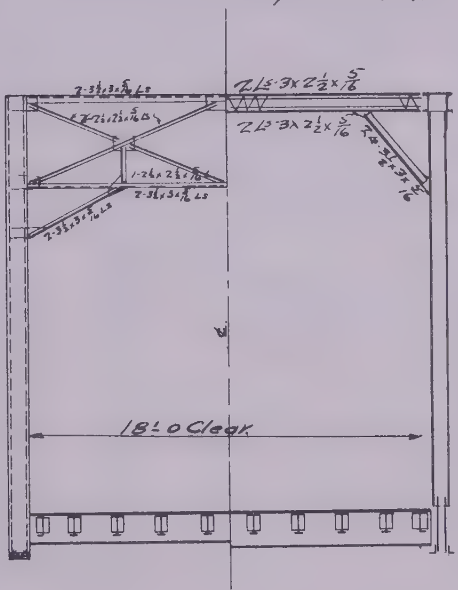
Stringer
Max Moment.
D.L = 1,930'#
L.L = 27,400
27,330 × 12/13000 = 27.1
Use 12 I 31½ - S = 36

End Shear -
D.L = 6,750#
L.L = 3,240
9,990

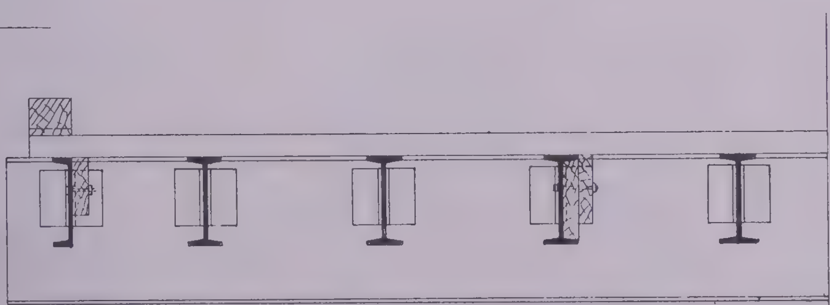
Floor Beam -
Max Mom -
D.L = 21,000'#
L.L = 113,000
134,000 × 12/13000 = 124
Use 20 I 65 - S = 117

End Shear -
D.L = 4,420#
L.L = 25,000
29,420

Data -
Dead Load per panel per truss = 8,100#
Live Load " " " " = 13,800
Specifications - Man. Gov. - 1912
Cooper's - 1909

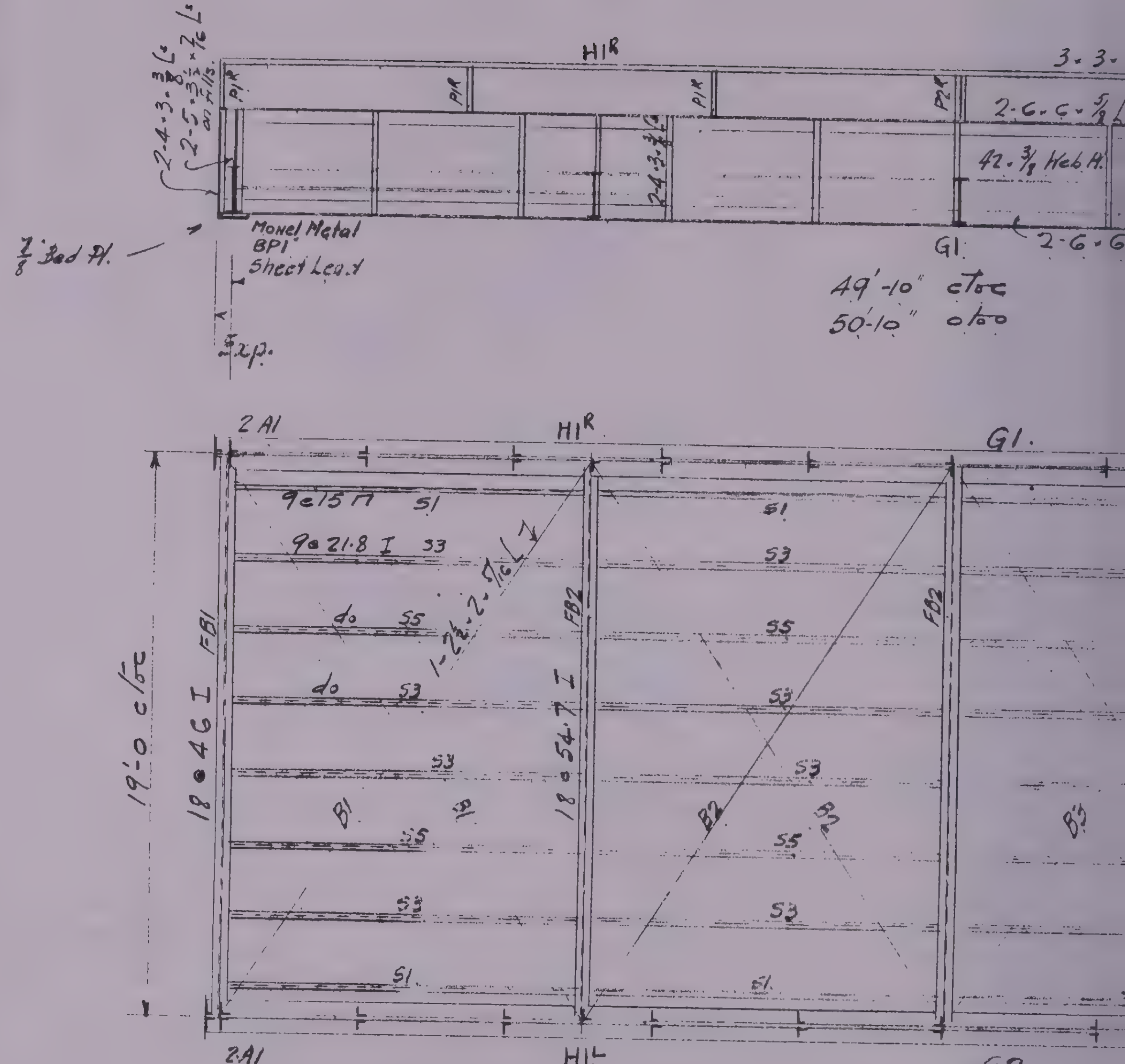


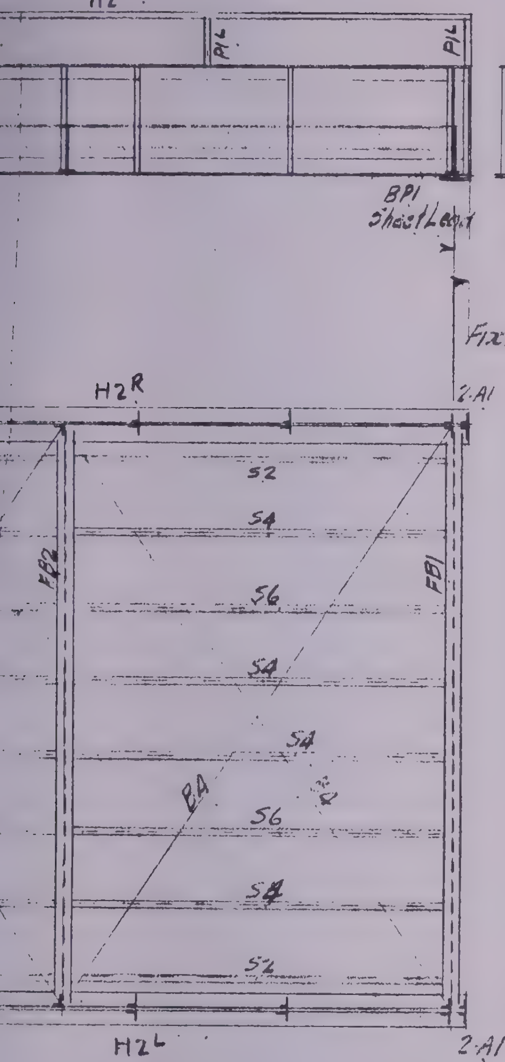
DOMINION BRIDGE CO., LIMITED
WINNIPEG
PROPRIETOR Gov't of Manitoba
DESCRIPTION 129'-6" Highway Span, Swan River - Man.
PURCHASER Algoma Steel Bridge Co.
DETAIL Erection Diagram.
MADE BY R.S. DATE June 8th 1914
CHECKED BY ... DATE ...
CONTRACT W1050 DRAWING 101
INDEX ...

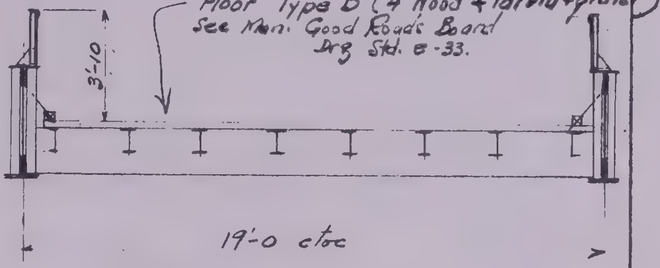


STRESS SHEET
TO
BRIDGE PLAN F17
MANITOBA GOVERNMENT

A
1-1750
March 14-14.


H1R
P1R
P2R
G1
2-6-6-5/8
42-3/8 Web Pl.
Monel Metal
BP1
Sheet Lead
7/8" Bed Pl.
Exp.
49'-10" c/c
50'-10" o/o
2 A1
G1.
9@15 ⊓
9@21.8 I
S1
S3
S5
do
18@46 I
18@54.7 I
FB1
FB2
19'-0 c/c
B1
B2
B3
2 A1
H1L
G2





Live Load - 80# per sq ft Roadway
15 Ton Motor Truck

Rivets $\frac{3}{4}\phi$ - holes punched $\frac{13}{16}\phi$

Conn. Ls of FBs & Str. to be assembled square & to exact length.

Floor Iron as per
Man. Good Roads Board
Drg. Std. e-33.

Girders are at present in D.B Yard
To be altered as necessary.

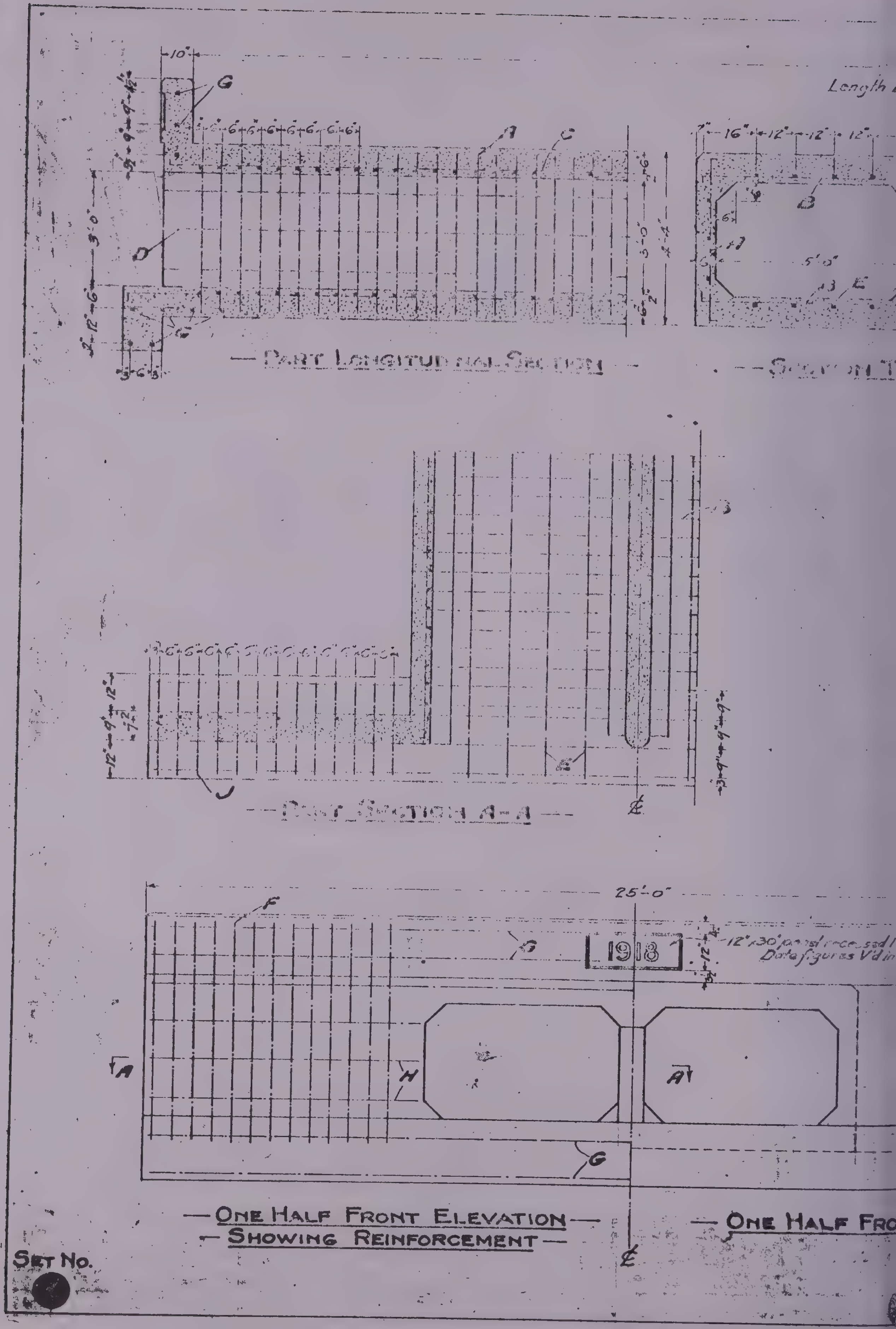
W1776
HIGHWAY BRIDGE
GILBERT PLAINS
MAN.
50 Ft Through Girder Span.

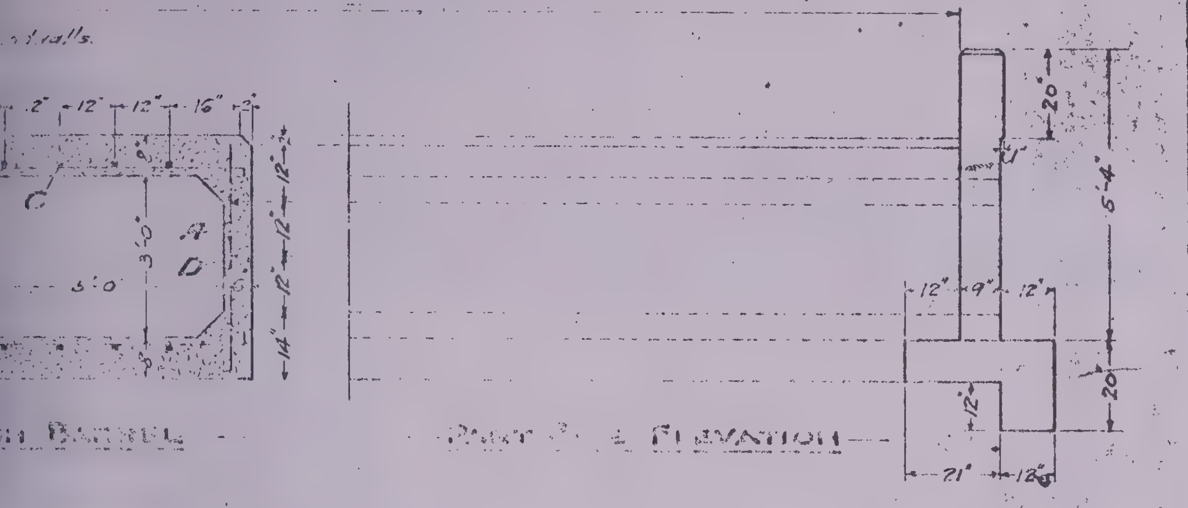
Note: Bridge Deck material to be shipped to Gilbert Plains [illegible] stored there by Municipality until ready to use

DOMINION BRIDGE CO. LIMITED WINNIPEG, MAN.	
DESIGN	SCALE 1 inch = 4 feet
DRAWING W.T.- 9939-1-C	
DESIGN BY WWW	DRAWN BY WD. DATE Dec. 13/22

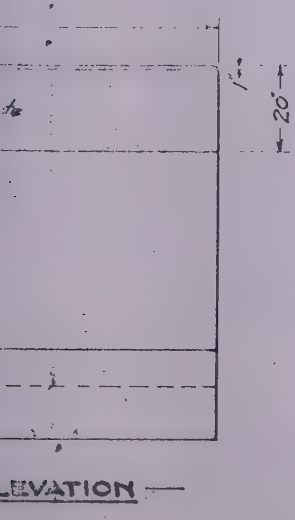
E1

Design "A"


Length
— PART LONGITUDINAL SECTION —
— SECTION
— PART SECTION A-A —
25'-0"
1918
12"x30" panel recessed
Date figures ¾" in
— ONE HALF FRONT ELEVATION —
— SHOWING REINFORCEMENT —
— ONE HALF FRO
SET No.



Mark	No.	Size	Length	Location	Sketch
BILL of Bars					
A	[illegible]	½"	4'-4"	Vertical Sides	5'10"
B	[illegible]	½"	11'-5"	Transv Top & Bottm	11'-2"
C	8	½"	[illegible]	Longit Top Slab	
D	9	½"	[illegible]	" Sides & Partn	
E	8	½"	[illegible]	" Bottom Slab	
F	52	½"	6'-0"	Vertical Head Wall	5'6"
G	13	½"	25'-0"	Longit " "	24'6"
H	12	½"	1'0"	" " "	5'9"
J	52	½"	2'9"	Transv Footgs	2'3"



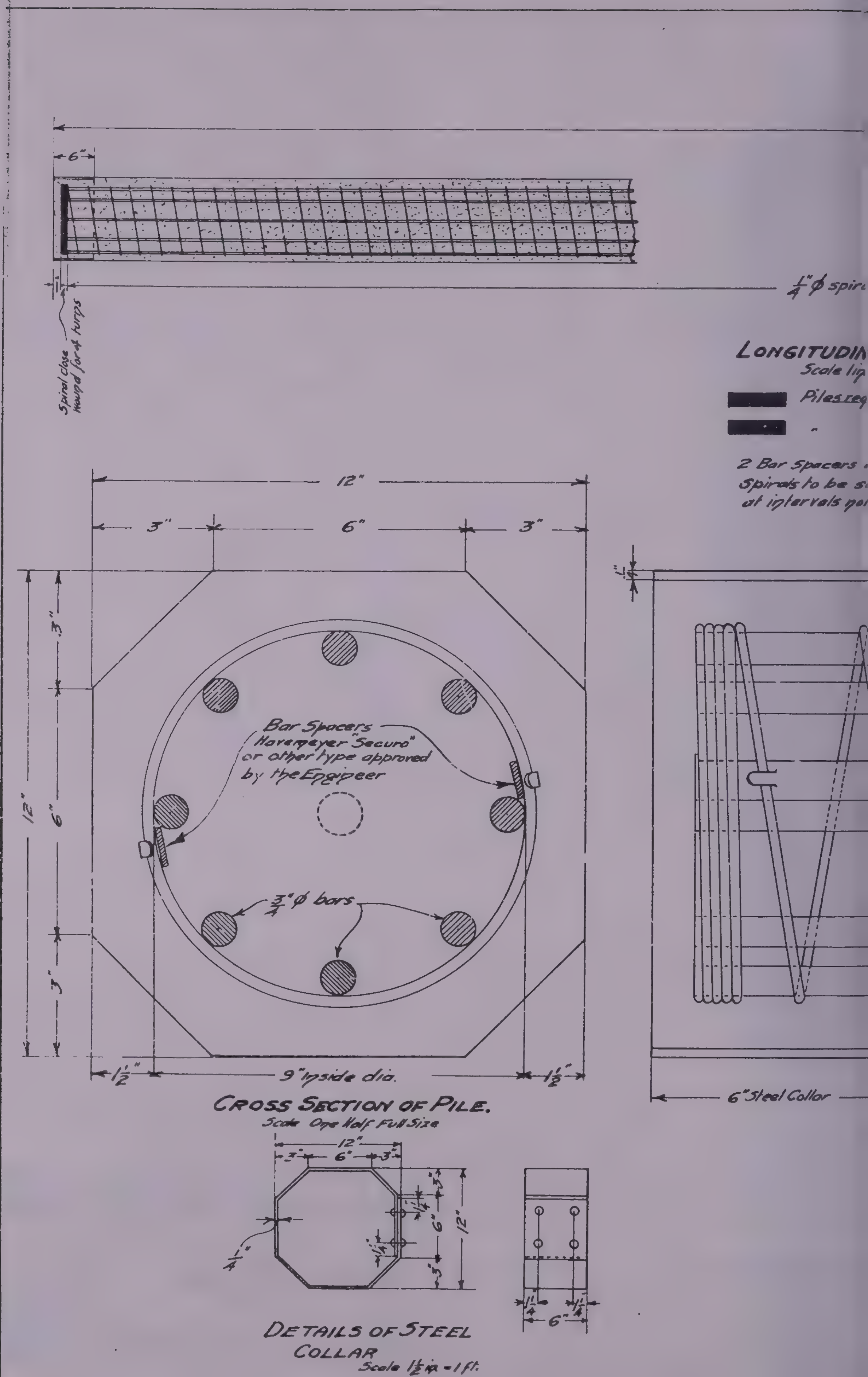
ST'D
110.

DOUBLE 3'x5'
REINFORCED CONCRETE
CULVERT

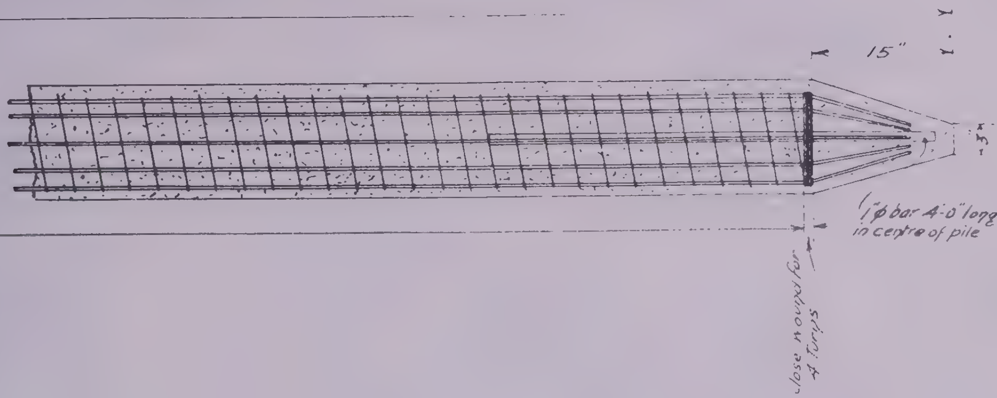
Dept. of Public Works
Highway Commissioner's Office
[redacted] Manitoba

Designed by T.B.A. Design checked by .... Traced by H.H.
Dimensioned by [redacted] Dimensions Checked by [redacted]
Approved by ....
Highway Commissioner.

SCALE ½ IN. = 1 FT. SHEET No. [redacted] PLAN No. [redacted]


6"
Spiral close wound for 4 turns
12"
3"
6"
3"
Bar Spacers Havemeyer "Securo" or other type approved by the Engineer
$\frac{3}{4}$"φ bars
9" inside dia.
$1\frac{1}{2}$"
6" Steel Collar
CROSS SECTION OF PILE.
Scale One Half Full Size
DETAILS OF STEEL COLLAR
Scale $1\frac{1}{2}$ in = 1 ft.

x= [redacted]



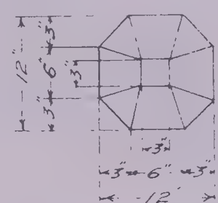
pitch

CTION.

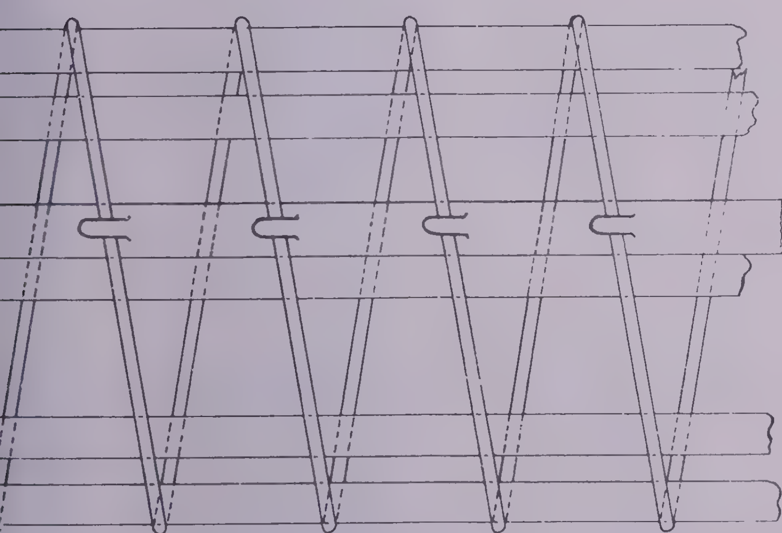
= [redacted]

= [redacted]

red for each pile. Spacers to be wired to $\frac{3}{4}$"ø bars
to $\frac{3}{4}$"ø bars with wire, or retaining devices approved by the Engineer.
r than 24" along each $\frac{3}{4}$"ø bar.



PLAN OF POINT.
Scale 1 in = 1 ft.



WINDING DETAIL AT HEAD OF PILE.
Scale One Half Full Size

BY E.W.M.J.	DATE July 25 1927
3/4"ø bars substd. for 5/8"□ bars	
2 bar spcrs	4 bar spcrs

STD C-70

20 FT.—35 FT.
REINF. CONCRETE PILE

[redacted]

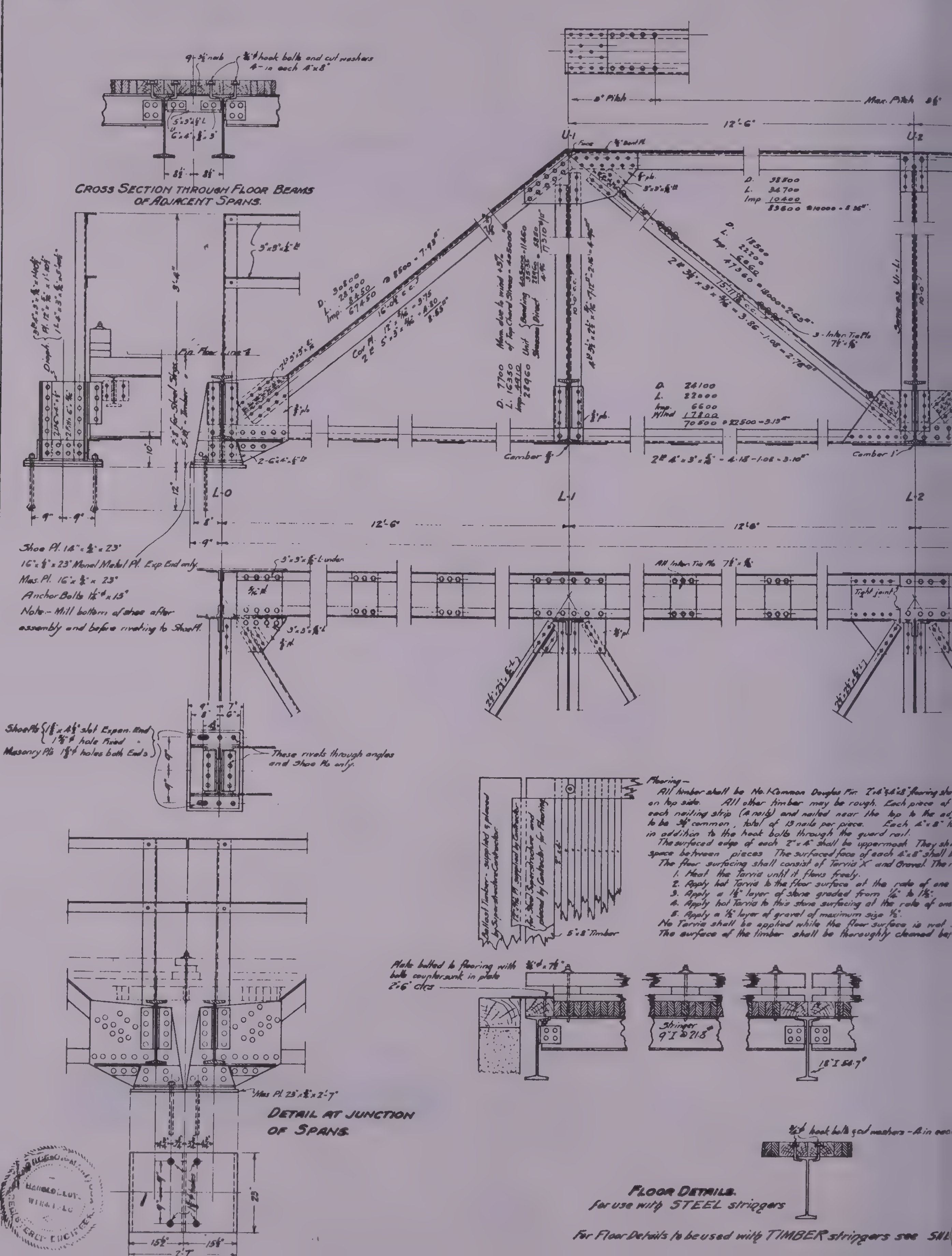
DEPARTMENT OF ... GOOD ROADS ... MAN...

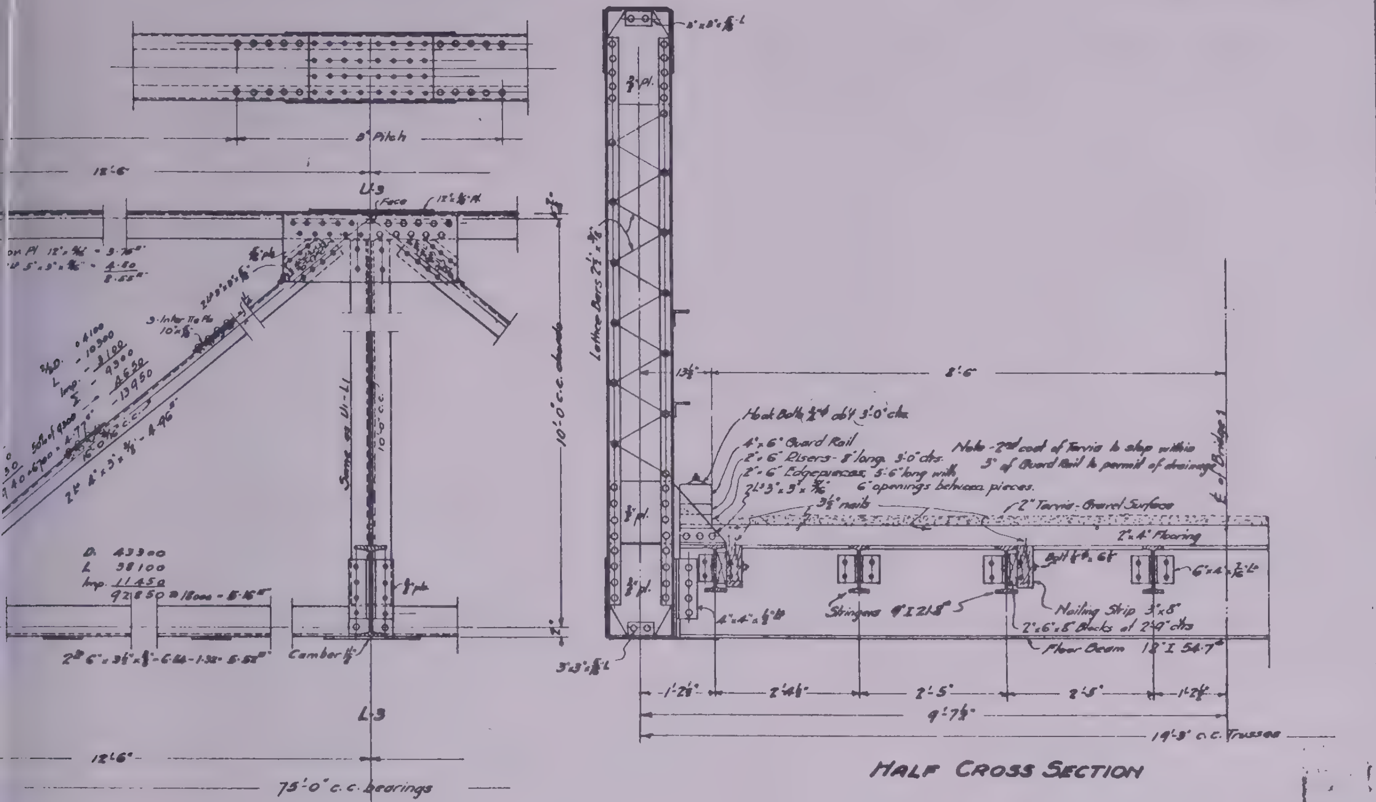
E.S.K. ... E.W.M.J. ... E.W.M.J.

[redacted]

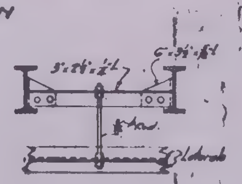
[redacted]

NOTED


CROSS SECTION THROUGH FLOOR BEAMS OF ADJACENT SPANS.
3/4" hook bolts and cut washers 4 - in each 4"x8"
Max. Pitch
12'-6"
U-1
U-2
L-0
L-1
L-2
D. 38800
L. 34700
Imp 10400
83600
D. 30800
L. 28200
Imp. 8450
67450
D. 24100
L. 22000
Imp. 6600
Wind 17800
70500
D. 7700
L. 16350
Imp. 4910
28960
Camber 5/8"
Camber 1"
Shoe Pl. 16" x 1/2" x 23"
16" x 1/8" x 23" Monel Metal Pl. Exp End only
Mas. Pl. 16" x 1/2" x 23"
Anchor Bolts 1 1/4" x 15"
Note.- Mill bottom of shoe after assembly and before riveting to Shoe Pl.
All Inter. Tie Pls 7 1/2" x 5/16"
Tight joint
These rivets through angles and Shoe Pls only.
Flooring -
All timber shall be No. 1 Common Douglas Fir.
1. Heat the Tarvia until it flows freely.
2. Apply hot Tarvia to the floor surface at the rate of one
3. Apply a 1 1/2" layer of stone graded from 1/4" to 1 1/2".
4. Apply hot Tarvia to this stone surfacing at the rate of one
5. Apply a 1/2" layer of gravel of maximum size 1/2".
No Tarvia shall be applied while the floor surface is wet.
The surface of the timber shall be thoroughly cleaned be
5"x8" Timber
Plate bolted to flooring with bolts countersunk in plate 2'-6" Ctrs
Stringer 9" I @ 21.8#
18" I 54.7#
Mas. Pl. 23" x 1/2" x 2'-7"
DETAIL AT JUNCTION OF SPANS.
FLOOR DETAILS.
for use with STEEL stringers
For Floor Details to be used with TIMBER stringers see



HALF CROSS SECTION



DETAIL OF LATERAL HANGER

NOTE:- These Bills apply only to cases in which STEEL stringers are to be used. For Bills pertaining to use of TIMBER stringers see SHEET NO. [redacted] of PLAN NO. [redacted]

BILL OF TIMBER (one span)

No	Description	Size	Length	Remarks	F.B.M.
24	Nailing Strips	3"x 8"	12'-0"	Rough	576
7	Blocking	2"x 6"	12'-0"	"	84
500	Flooring	2"x 4"	18'-0"	S.1S.1E	6000
10	"	4"x 8"	18'-0"	"	480
2	"	5"x 8"	18'-0"	Rough	120
12	Guard Rails	4"x 6"	14'-0"	S.1S.1E.	336
13	Edgepieces & Risers	2"x 6"	14'-0"	Rough	182
2	Ballast Timbers	8"x 12"	18'-0"	"	288
				Total	8066

APPROXIMATE QUANTITIES. (one span)

Steel .... 20 tons
Steel deck plates, bolts and bevel washers .... 470 lbs
60 Hook bolts & C.I. Washers (Guard Rails) .... 205 "
40 " " & Cut " (4"x 8") .... 50 "
120 Bolts through nailing strips .... 68 "
3 1/2" Wire nails .... 134 "
Tarvia "X" .... 190 gals
Gravel { maximum size 1/2" .... 2 cu. yds
{ 1/4" to 1/2" .... 6 " "

... and the guard rail surfaced ... ing shall be toe-nailed to ... ce with 9 nails. All nails ... ed with 4 - 3/4"ϕ hook bolts

... light so that there is no ... at

... plication shall be as follows-

... r lin. ft. of bridge.

... r lin. ft. of bridge.

... g Tarvia.

Stringer
D.L. - 122# per lin. ft.

Shear	D.L.	762#	Mom.	D.L.	28600'#	$S. = \frac{321100}{18000} = 17.8$
	L.L.	6750		L.L.	225000	
	Imp.	2025		Imp.	67500	9" I 21.8# - 18.9
	Total	9537#		Total	321100'#	

Inter. Floor Beam
D.L. = 664# per lin. ft.

Shear	D.L.	6480#	Mom.	D.L.	379000'#	$S. = \frac{1579000}{18000} = 87.8$
	L.L.	16350		L.L.	923000	
	Imp.	4900		Imp.	277000	18" I 54.7# = 88.4
	Total	27730#		Total	1579000'#	

End Floor Beam
D.L. - 359# per lin. ft.

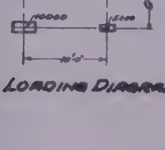
Shear	D.L.	3500#	Mom.	D.L.	205000'#	$S. = \frac{1405000}{18000} = 78$
	L.L.	16350		L.L.	923000	
	Imp.	4900		Imp.	277000	18" I 54.7# - 88.4
	Total	24750#		Total	1405000'#	

Specifications - Canadian Engineering Standards Association Specification No 6-1922 for Steel Highway Bridges, except that unit stress for tension is 18000#/□"

Loading - Dead Load = 617# per lin. ft. of truss.
Live Load = 80 lbs per sq. ft. of roadway 17'-0 wide or one 15 ton motor truck + 30% impact.

Rivets - Rivets 3/4" ϕ - Holes in all connections shall be subpunched 5/8" ϕ and reamed to 13/16" ϕ. Holes in cover plates, tie plates, lattice bars and laterals may be punched full size. Field rivets shall be power driven.

Camber - The camber shown is that which would be derived by increasing the length of the top chord 1/8" in 10'-0. The lengths of the truss members are calculated by considering each vertical member remaining in a vertical position and raised the amount of camber at that point.



LOADING DIAGRAM.

[redacted] PLAN NO. [redacted]

STD. 8-43
Dec. 1927 Sheet 1/2

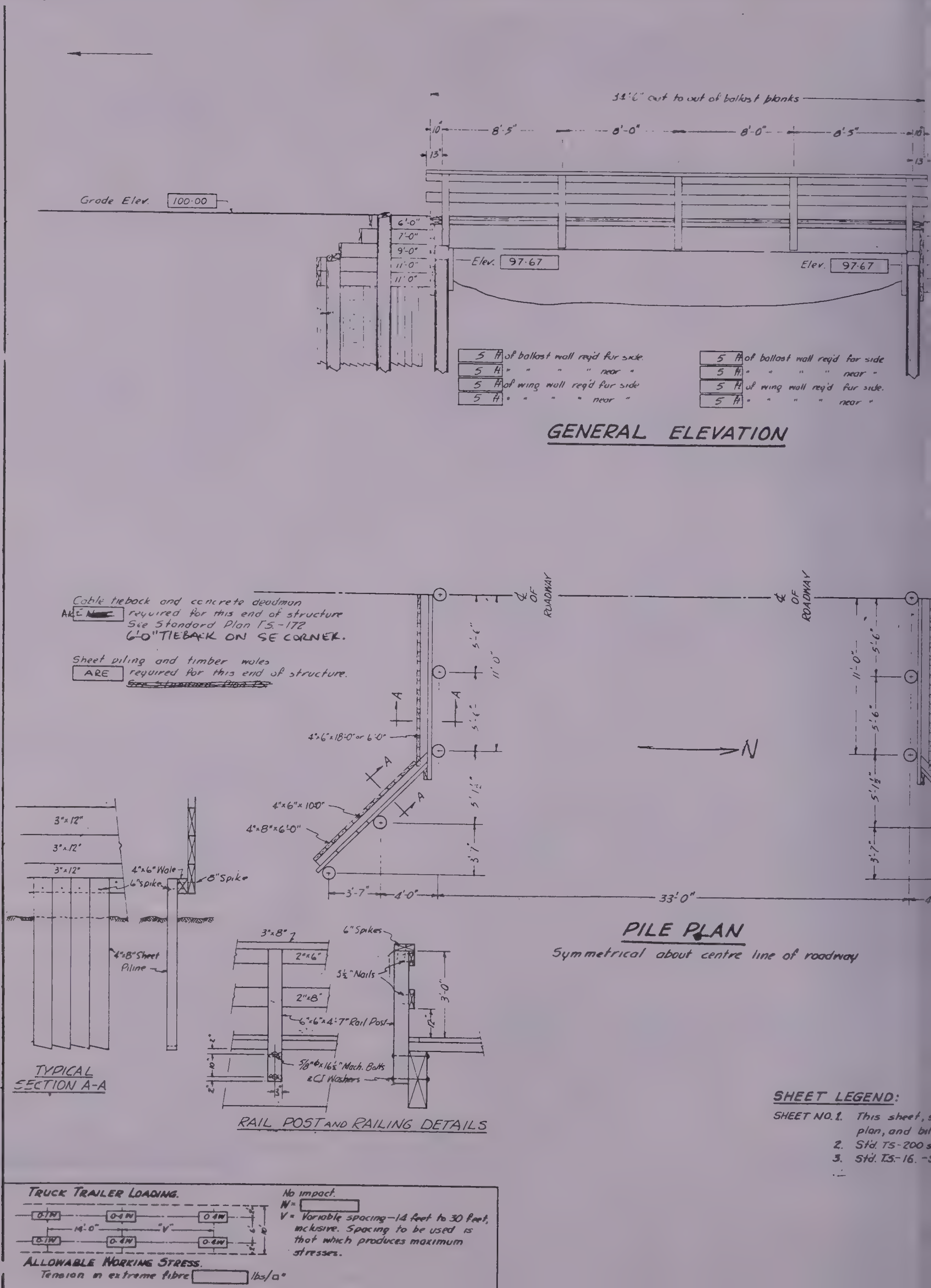
18 FT. ROADWAY

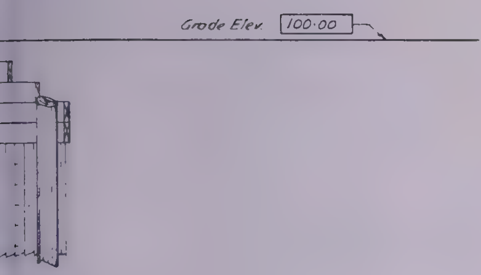
75 FT. LOW RIVETED WARREN TRUSS

[redacted]

DEPARTMENT OF PUBLIC WORKS
GOOD ROADS BOARD
MANITOBA

Designed by ... H.L. ... Drawn by ... H.L. ... Traced by H.L.
Engineer in Charge [redacted] Checked by R.J.T.
Approved by ... M. A. Lyons ... Chief Engineer
Date. [redacted]
SCALE 1/2" & 3/4" = 1'-0 SHEET No [redacted] PLAN No [redacted]


34'-6" out to out of ballast planks
10" 8'-5" 8'-0" 8'-0" 8'-5" 10"
13" 13"
Grade Elev. 100.00
6'-0"
7'-0"
9'-0"
11'-0"
11'-0"
Elev. 97.67
Elev. 97.67
5 ft of ballast wall req'd for side.
5 ft " " " near "
5 ft of wing wall req'd for side
5 ft " " " near "
5 ft of ballast wall req'd for side
5 ft " " " near "
5 ft of wing wall req'd for side.
5 ft " " " near "
GENERAL ELEVATION
Cable tieback and concrete deadman ARE required for this end of structure
See Standard Plan TS-172
6'-0" TIEBACK ON SE CORNER.
Sheet piling and timber wales ARE required for this end of structure.
℄ OF ROADWAY
℄ OF ROADWAY
5'-6"
11'-0"
5'-6"
4"x6"x18'-0" or 6'-0"
A
N
4"x6"x10'-0"
4"x8"x6'-0"
5'-1½"
3'-7"
3'-7" 4'-0" 33'-0"
PILE PLAN
Symmetrical about centre line of roadway
3"x12"
3"x12"
3"x12"
4"x6" Wale
6" spike
8" Spike
4"x8" Sheet Piling
TYPICAL SECTION A-A
3"x8"
2"x6"
2"x8"
6" Spikes
5½" Nails
3'-0"
6"x6"x4'-7" Rail Post
5/8"φx16½" Mach. Bolts & CI Washers
RAIL POST AND RAILING DETAILS
SHEET LEGEND:
SHEET NO. 1. This sheet, plan, and bi
2. Std. TS-200 s
3. Std. TS-16. -
TRUCK TRAILER LOADING.
0.1W 0.4W 0.4W
14'-0" "V"
0.1W 0.4W 0.4W
6'-0"
No impact.
W=
V = Variable spacing—14 feet to 30 feet, inclusive. Spacing to be used is that which produces maximum stresses.
ALLOWABLE WORKING STRESS.
Tension in extreme fibre lbs/□"



BILL OF TIMBER

PLATE No. 8

MK	NO	DESCRIPTION	SIZE	LENGTH	REMARKS	F.B.M.
F2	2	CAPS	12½"x12"	26'-0"	See Std TS-200	624
	13	STRINGERS	8"x24"	34'-0"	do	7072
	10	GUARD RAIL POSTS	6"x6"	4'-7"	Use 6"x6"x 14'-0" pieces.	141
	2	END FLOOR PLANKS	6"x10"	26'-0"	See Std TS-200	260
L1	10	CLAMPS	4"x6"	4'-0"	do	80
L1	10	do	do	3'-0"	do	60
	20	BALLAST PLANKS	3"x12"	13'-0"		780
H1	4	WING PLANKS	do	6'-0"	See Std. TS-200.	72
H2	4	do	do	7'-0"	do	84
H3	4	do	do	9'-0"	do	108
H4	8	do	do	11'-0"	do	264
	4	BATTENS	3"x10"	5'-0"	do	50
		CENTRE SCREED	3"x6"	32 Lin ft	S4S	48
		EDGE SCREED	2"x4"	62 Lin ft	S4S	41
	250	DECKING	do	16'-0"	S4S	2667
	250	do	do	8'-0"	S4S	1333
	4	WALES	4"x6"	10'-0"		80
	2	do	do	24'-0"	Use 6' & 18' pieces.	96
	128	SHEET PILING	4"x8"	6'-0"		2048
	4	GUARD RAILING	3"x8"		S4S (Untreated) Top Rail.	144
	4	do	2"x6"		S4S do Under Top Rail.	72
	4	do	2"x4"		S4S do Hub Rail.	96
					TOTAL F.B.M.	16,228

All timber to be "Rough" unless otherwise noted on these details

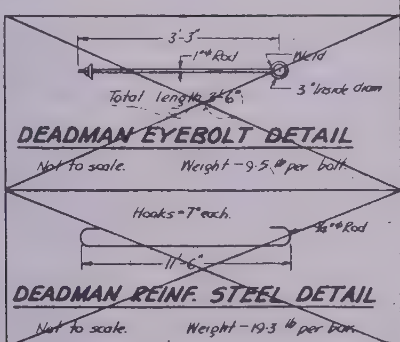
BILL OF IRON

MK	NO.	DESCRIPTION	SIZE	LENGTH	LOCATION	LB.
A	10	DRIFT BOLTS	¾"φ	20"	Caps to piles	25
C	26	do	½"φ	28"	Stringers to caps	41
D	8	MACHINE BOLTS	½"φ	7½"	Battens to ballast planks	4
F	20	do	⅝"φ	16½	2 to each [illegible]	31
J	20	do	¾"φ	26½"	Clamps to piles and caps	70
~~F~~		~~do~~	~~do~~	~~20"~~	~~Rail post brackets~~	
		~~EYEBOLTS~~	~~1"φ~~	~~3'-3"~~	~~See detail concrete deadman~~	
N	40	CI WASHERS	¾"		2 to each bolt "J"	40
O	40	do	⅝"		2 to each bolt "F"	23
		~~do~~	~~1"~~		~~1 to each 1" eyebolt~~	
	16	CUT WASHERS	½"	⅛" thick	2 to each bolt "D"	1
		~~GALV. SHEET IRON~~	~~#16 ga~~	~~6"x24"~~	~~Around piles under [illegible]~~	
		~~REINF. STEEL~~	~~¾"φ~~	~~12'-8"~~	~~8 per concrete deadman~~	
		COMMON WIRE NAILS	3½"		Decking, fillers under stringers	200
		do	5"		Battens, rail post clips	4
		do	6"		Ballast & wing planks	40
	10	GALV. SHEET IRON	#26 ga.	15"x15"	Over piles under caps	12
		COMMON WIRE NAILS	8"		Wales to ballast & wing walls	6
					TOTAL WT. (LBS.)	495

NOTE: Bolts "D" & "F" to have thread 2½" long.
do J do do 4" do
Holes for all machine bolts to be bored ⅛" larger than bolt.

Cable tieback and concrete deadman ~~ARE~~ required for this end of structure. See Standard Plan TS-172.
12'-0" TIEBACK

Sheet piling and timber wales ARE required for this end of structure. ~~See Standard Plan TS.~~



~~DEADMAN EYEBOLT DETAIL~~

~~Not to scale. Weight - 9.5 # per bolt~~

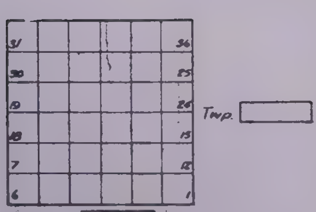
~~DEADMAN REINF. STEEL DETAIL~~

~~Not to scale. Weight - 19.3 lb per bar.~~

BILL OF PILES

14	Piles @	30'-0"	=	420	Lin. Ft.
4	do	15'-0"	=	60	do
	do		=		do
			TOTAL	480	Lin. Ft.

...general elevation, pile plan, location
...timber, iron, piles, and misc. quantities.
...timber framing details.
...d plan of 24 ft. roadway.



LOCATION PLAN

Std. T.S.-206

Std. Approved

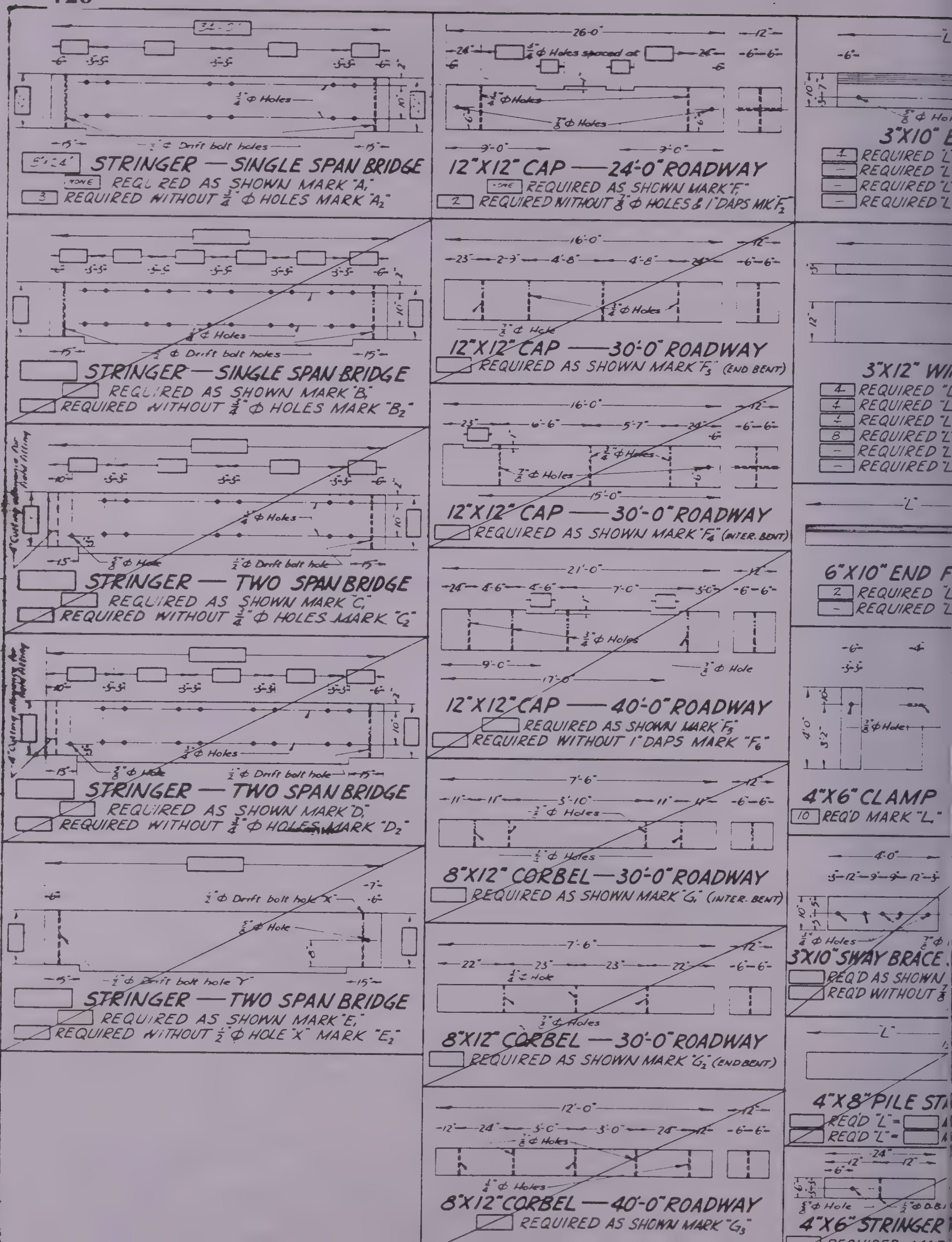
34'-6" TREATED TIMBER PILE BRIDGE

STREAM: Rennie River 18 24 FT. ROADWAY
LOCATION: Sta. 296 ~~32~~-11-15E ONE 33 FT. SPAN.
P.T.H. No. Brereton Lake Road.

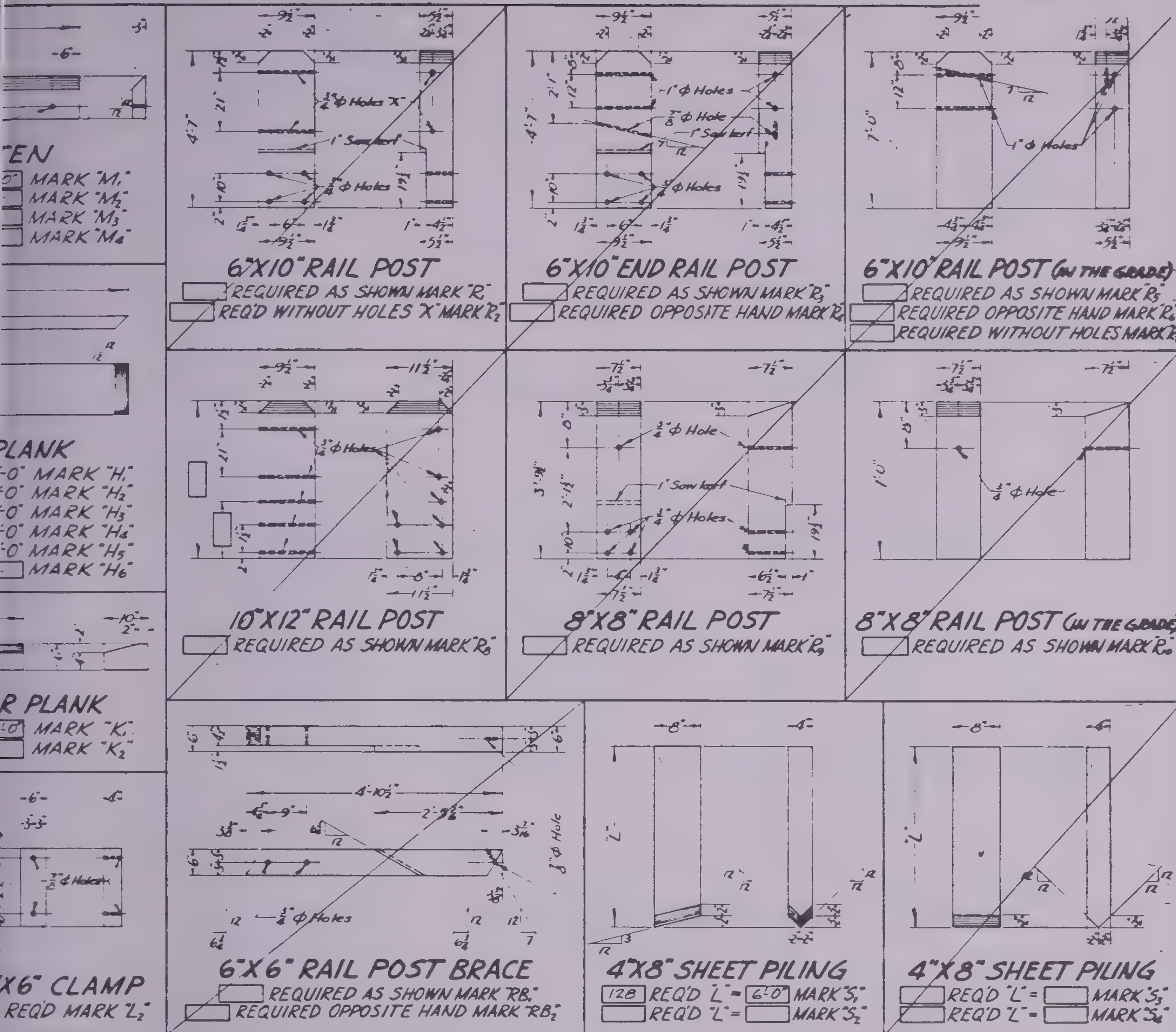
MUNICIPALITY OF WHITESHELL FOREST RESERVE

DEPARTMENT OF PUBLIC WORKS
HIGHWAYS BRANCH
MANITOBA

Designed by M.P.A. Drawn by M.P.A. Traced by M.P.A.
Engineer in Charge T. LAMB Checked by
Approved by
Chief Engineer
Date JAN. 24, 1952
Scale Sheet No. 1 Plan No. 2640



STRINGER — SINGLE SPAN BRIDGE
REQUIRED AS SHOWN MARK "A,"
3 REQUIRED WITHOUT ¾" Φ HOLES MARK "A₂"
12"X12" CAP — 24'-0" ROADWAY
REQUIRED AS SHOWN MARK "F,"
2 REQUIRED WITHOUT ⅞" Φ HOLES & 1" DAPS MK "F₂"
3"X10"
REQUIRED
STRINGER — SINGLE SPAN BRIDGE
REQUIRED AS SHOWN MARK "B,"
REQUIRED WITHOUT ¾" Φ HOLES MARK "B₂"
12"X12" CAP — 30'-0" ROADWAY
REQUIRED AS SHOWN MARK "F₃" (END BENT)
3"X12"
4 REQUIRED
4 REQUIRED
4 REQUIRED
8 REQUIRED
REQUIRED
REQUIRED
STRINGER — TWO SPAN BRIDGE
REQUIRED AS SHOWN MARK "C,"
REQUIRED WITHOUT ¾" Φ HOLES MARK "C₂"
12"X12" CAP — 30'-0" ROADWAY
REQUIRED AS SHOWN MARK "F₄" (INTER. BENT)
6"X10" END
2 REQUIRED
REQUIRED
STRINGER — TWO SPAN BRIDGE
REQUIRED AS SHOWN MARK "D,"
REQUIRED WITHOUT ¾" Φ HOLES MARK "D₂"
12"X12" CAP — 40'-0" ROADWAY
REQUIRED AS SHOWN MARK "F₅"
REQUIRED WITHOUT 1" DAPS MARK "F₆"
4"X6" CLAMP
10 REQ'D MARK "L,"
STRINGER — TWO SPAN BRIDGE
REQUIRED AS SHOWN MARK "E,"
REQUIRED WITHOUT ½" Φ HOLE "X" MARK "E₂"
8"X12" CORBEL — 30'-0" ROADWAY
REQUIRED AS SHOWN MARK "G," (INTER. BENT)
3"X10" SWAY BRACE
REQ'D AS SHOWN
REQ'D WITHOUT
8"X12" CORBEL — 30'-0" ROADWAY
REQUIRED AS SHOWN MARK "G₂" (END BENT)
4"X8" PILE
REQ'D "L" =
REQ'D "L" =
8"X12" CORBEL — 40'-0" ROADWAY
REQUIRED AS SHOWN MARK "G₃"
4"X6" STRINGER



GENERAL NOTES

1. Ends of all stringers must be cut square and true
2. The depth of shoulder will vary according to the depth of the rough stringer, but shall not be less than 2" or more than 3". The shoulder shall be cut square
3. All timber listed hereon shall be framed before treatment, and shall conform to the Specifications of the Highways Branch for "Green Timber and Piles for Preservative Treatment as set forth on form G.R. 28 dated May 30th 1936. Treatment of all timber listed hereon shall conform to the Specifications of the Highways Branch for "Preservative Treatment of Timber and Piling with Creosote Oil by the Pressure Process" as set forth on form G.R. 27 dated May 30th, 1936.

ST'D T.S. 200
REVISIONS-:

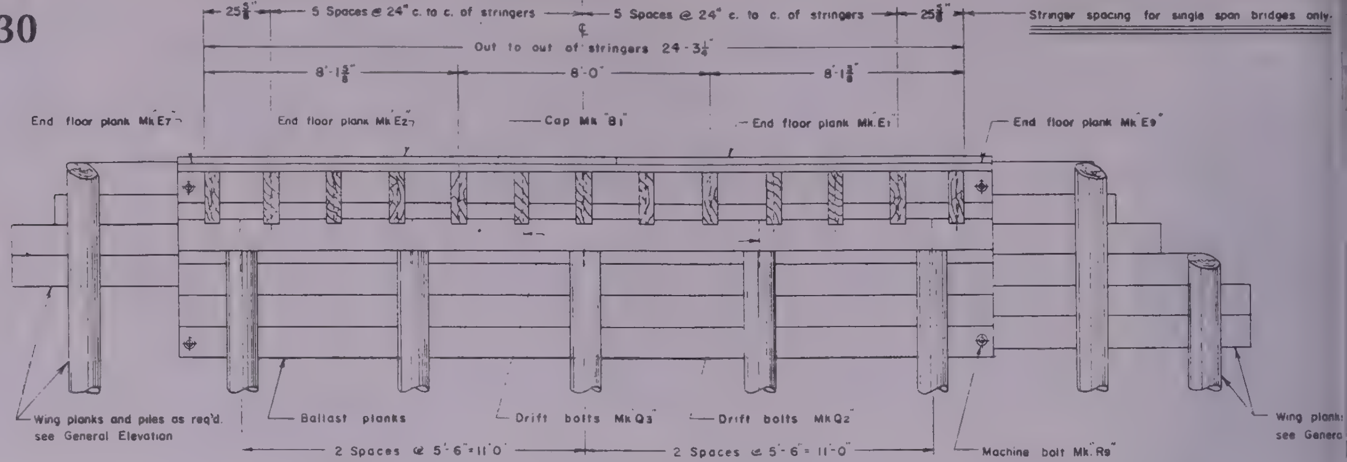
TIMBER DETAILS

34'-6" TREATED TIMBER PILE BRIDGE
LOCATION — 32-11-15E BRERETON LAKE ROAD P.T.H. No.
MUNICIPALITY OF WHITESHELL FOREST RESERVE

DEPARTMENT OF PUBLIC WORKS

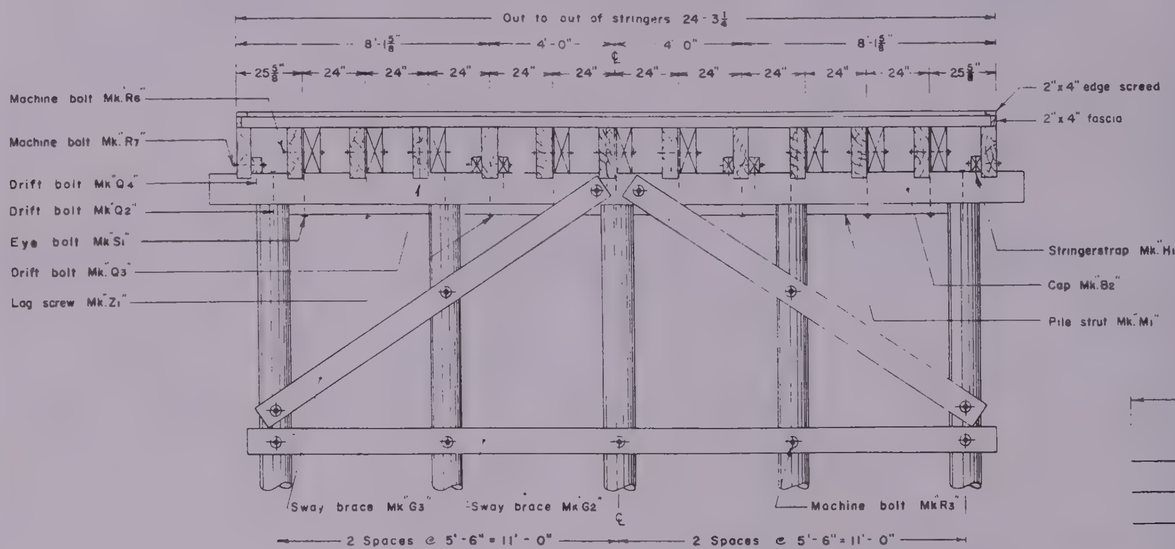
GFG GFG
E.W.M. James

December 4th, 1950
NOT TO SCALE
2640



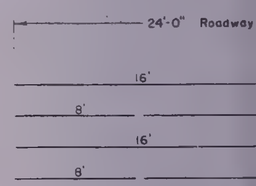
CROSS SECTION AT ABUTMENT

Clamps Mk L1 and decking are not shown



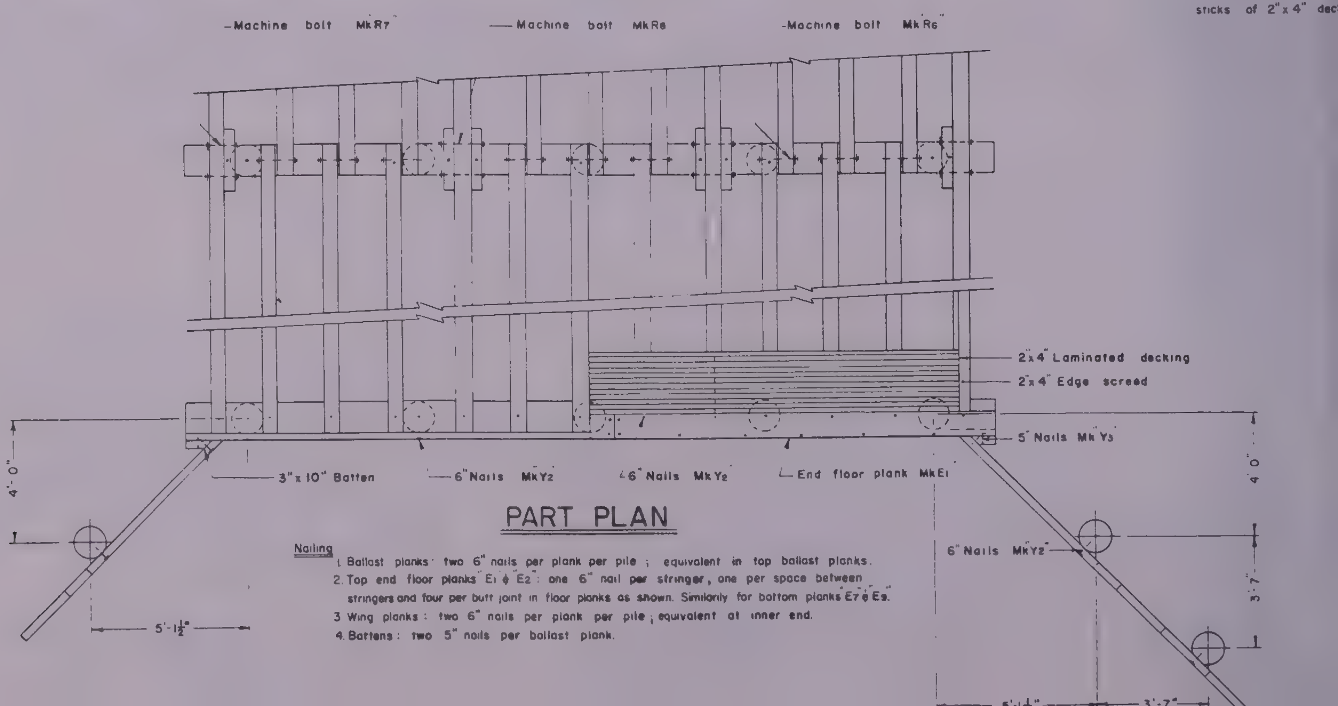
CROSS SECTION AT INTERMEDIATE BENT

Pile straps Mk V1 are not shown but shall be used on all piles in intermediate bents.



DECKING

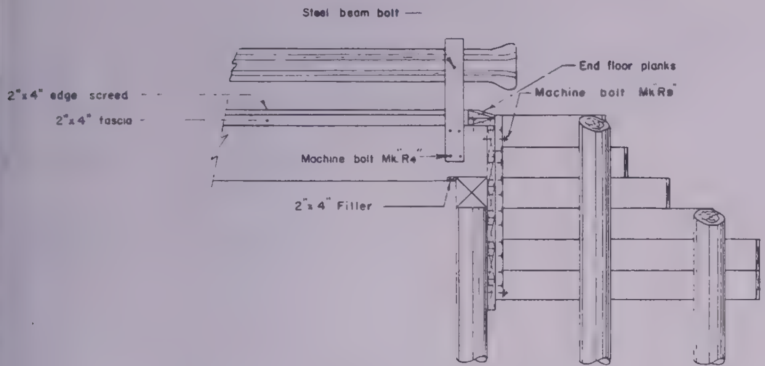
Line diagram showing layout of sticks of 2"x4" dec



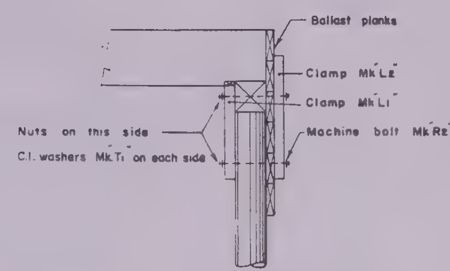
PART PLAN

Nailing

1. Ballast planks: two 6" nails per plank per pile; equivalent in top ballast planks.
2. Top end floor planks E1 & E2: one 6" nail per stringer, one per space between stringers and four per butt joint in floor planks as shown. Similarly for bottom planks E7 & E9.
3. Wing planks: two 6" nails per plank per pile; equivalent at inner end.
4. Battens: two 5" nails per ballast plank.

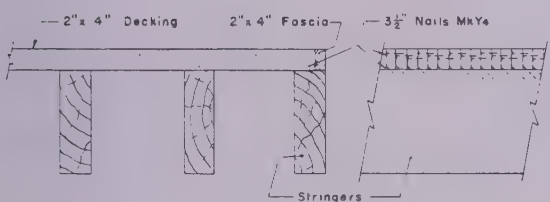


PART SIDE ELEVATION



DETAIL OF CLAMPS

Clamps on all piles of end bents

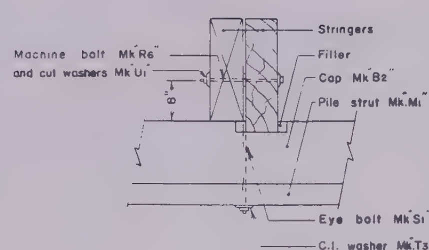


NOTE

Each piece of 2"x4" decking shall be toenailed to each stringer and nailed near the top to the adjoining piece of 2"x4".

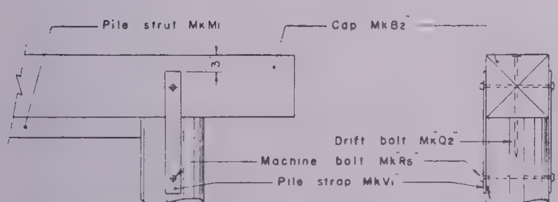
DECK NAILING DETAIL

Scale ¾" = 1'-0"



EYE BOLT ASSEMBLY DETAIL

For lapping stringers
Scale ¾" = 1'-0"

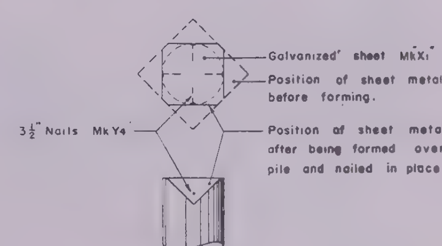


NOTE

Top of each pile to be trimmed to thickness of cap to accomodate steel pile straps

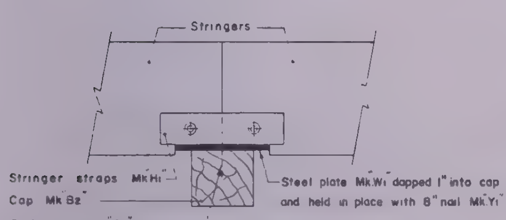
PILE STRAP ASSEMBLY DETAIL

Scale ¾" = 1'-0"



SHEET METAL PILE CAP

Sheet metal pile cap on each pile except for wingwall piles
Scale ¾" = 1'-0"



DETAIL OF BUTT JOINT

Steel plate MkW1" at interior butt joints only.
Scale ¾" = 1'-0"

NOTES

1. Cuts on piles and timber shall be given two coats of hot creosote oil.
2. All field bored holes shall be poured full of hot creosote oil before assembly.
3. Field drilled bolt holes to be bored $\frac{1}{16}$" larger than bolt diameter.
4. Stringer spacing shall be accurate so that decking sticks and bottom end floor planks will butt on ℄ of stringers.

ST'D. T.S. 309

REVISIONS

ST'D. APPROVED
CHIEF ENGINEER
DEC. — 1956

ASSEMBLY DETAILS

FOR TREATED TIMBER BRIDGE
FOR 24'-0" ROADWAY

E. OF SEC. 15-3-10E.

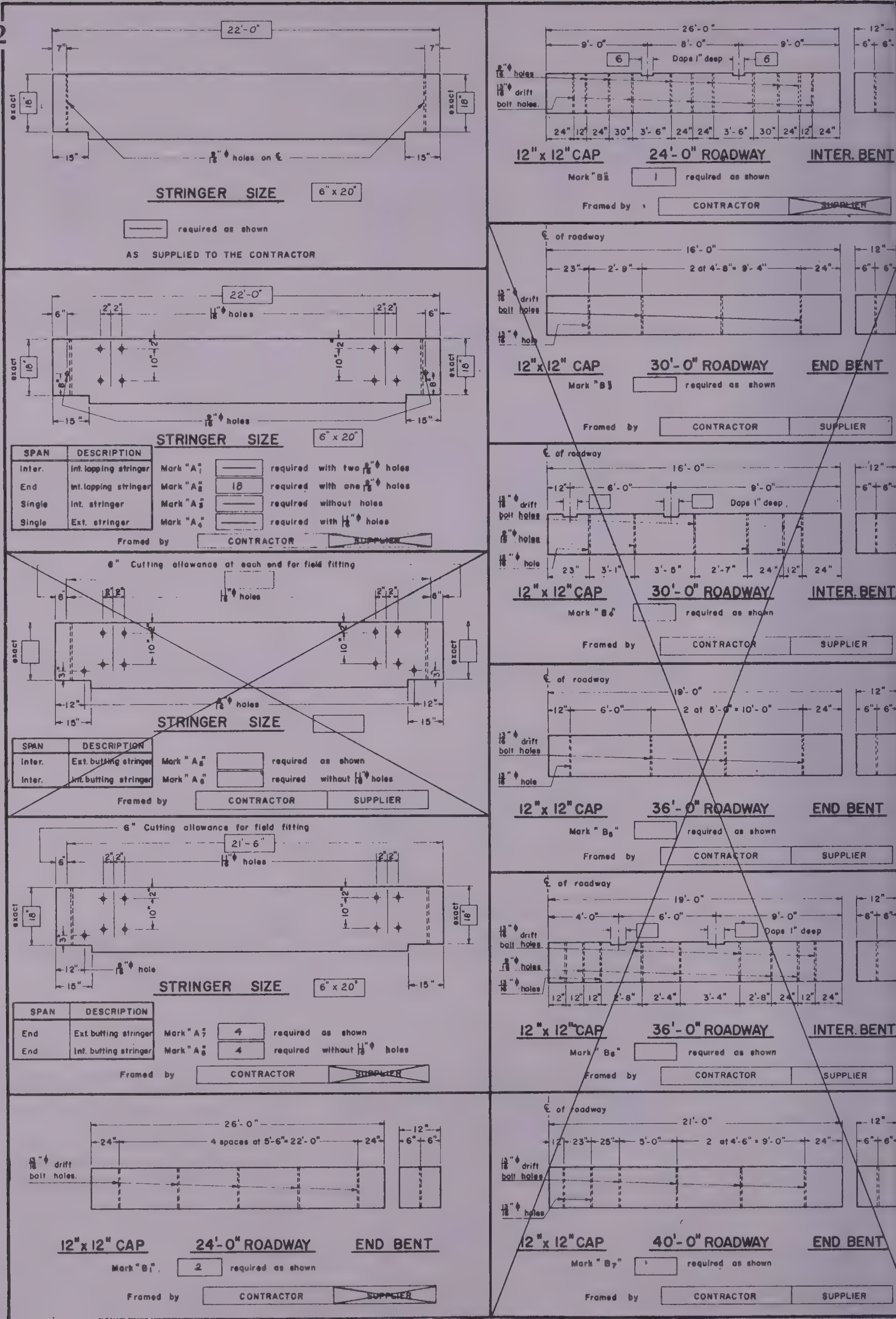
FROM P.T.H. NO. 12 TO WOODRIDGE STA. 192+46

PINEY DISORGANIZED

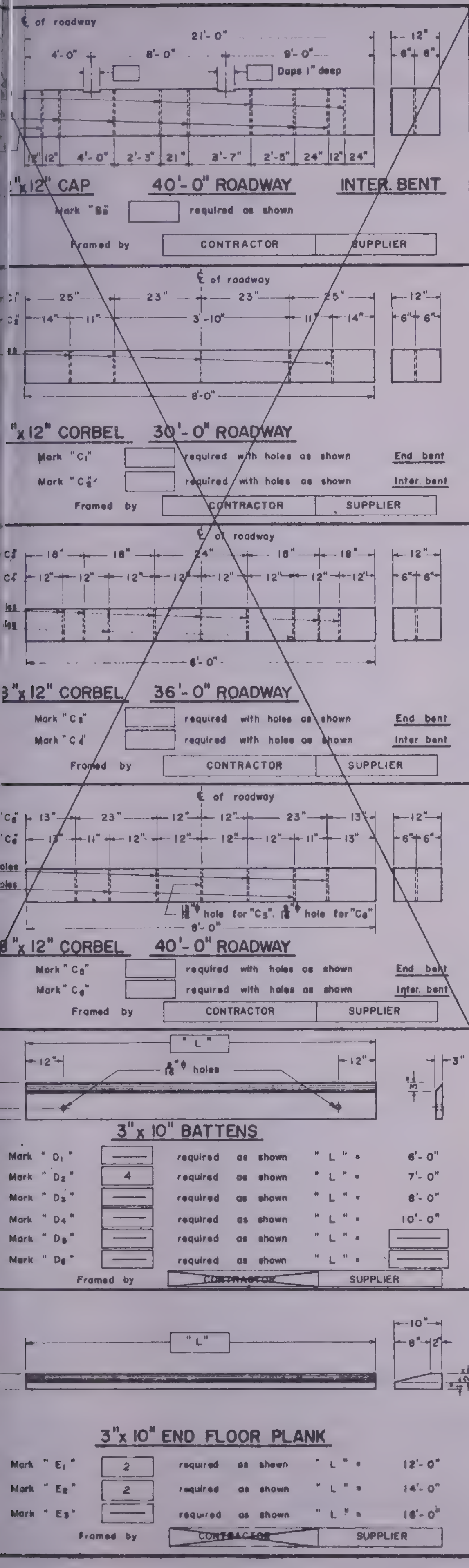
MANITOBA
CHIEF ENGINEER'S OFFICE
PUBLIC WORKS

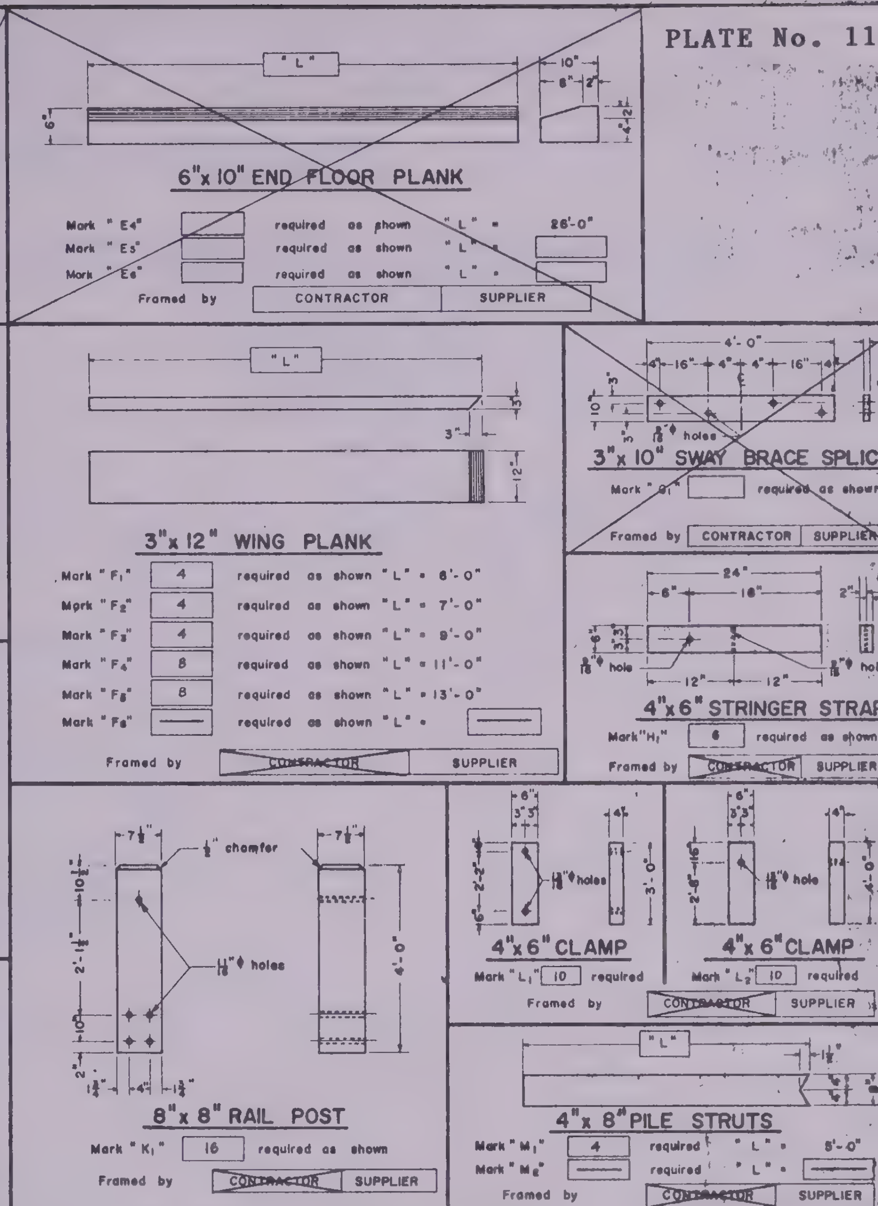
H.E.C. W.B. Traced by R.R.L.
Checked By H.E.C. & I.G.
CHIEF ENGINEER

Date June 1957
Scale ⅜"=1'-0" or as shown
NO. 3/3
PLAN NO: 2885



STRINGER SIZE 6" x 20"
22'-0"
required as shown
AS SUPPLIED TO THE CONTRACTOR
STRINGER SIZE 6" x 20"
SPAN DESCRIPTION
Inter. Int. lapping stringer Mark "A1" required with two holes
End Int. lapping stringer Mark "A2" 18 required with one holes
Single Int. stringer Mark "A3" required without holes
Single Ext. stringer Mark "A4" required with holes
Framed by CONTRACTOR SUPPLIER
6" Cutting allowance at each end for field fitting
STRINGER SIZE
SPAN DESCRIPTION
Inter. Ext. butting stringer Mark "A5" required as shown
Inter. Int. butting stringer Mark "A6" required without holes
Framed by CONTRACTOR SUPPLIER
6" Cutting allowance for field fitting
21'-6"
STRINGER SIZE 6" x 20"
SPAN DESCRIPTION
End Ext butting stringer Mark "A7" 4 required as shown
End Int. butting stringer Mark "A8" 4 required without holes
Framed by CONTRACTOR SUPPLIER
26'-0"
4 spaces at 5'-6" = 22'-0"
drift bolt holes.
12"x 12" CAP 24'-0" ROADWAY END BENT
Mark "B1" 2 required as shown
Framed by CONTRACTOR SUPPLIER
26'-0"
Daps 1" deep
12"x 12" CAP 24'-0" ROADWAY INTER. BENT
Mark "B2" 1 required as shown
Framed by CONTRACTOR SUPPLIER
℄ of roadway
16'-0"
2 at 4'-8" = 9'-4"
12"x 12" CAP 30'-0" ROADWAY END BENT
Mark "B3" required as shown
Framed by CONTRACTOR SUPPLIER
℄ of roadway
16'-0"
Daps 1" deep
12"x 12" CAP 30'-0" ROADWAY INTER. BENT
Mark "B4" required as shown
Framed by CONTRACTOR SUPPLIER
℄ of roadway
19'-0"
2 at 5'-0" = 10'-0"
12"x 12" CAP 36'-0" ROADWAY END BENT
Mark "B5" required as shown
Framed by CONTRACTOR SUPPLIER
℄ of roadway
19'-0"
Daps 1" deep
12"x 12" CAP 36'-0" ROADWAY INTER. BENT
Mark "B6" required as shown
Framed by CONTRACTOR SUPPLIER
℄ of roadway
21'-0"
2 at 4'-6" = 9'-0"
12"x 12" CAP 40'-0" ROADWAY END BENT
Mark "B7" required as shown
Framed by CONTRACTOR SUPPLIER

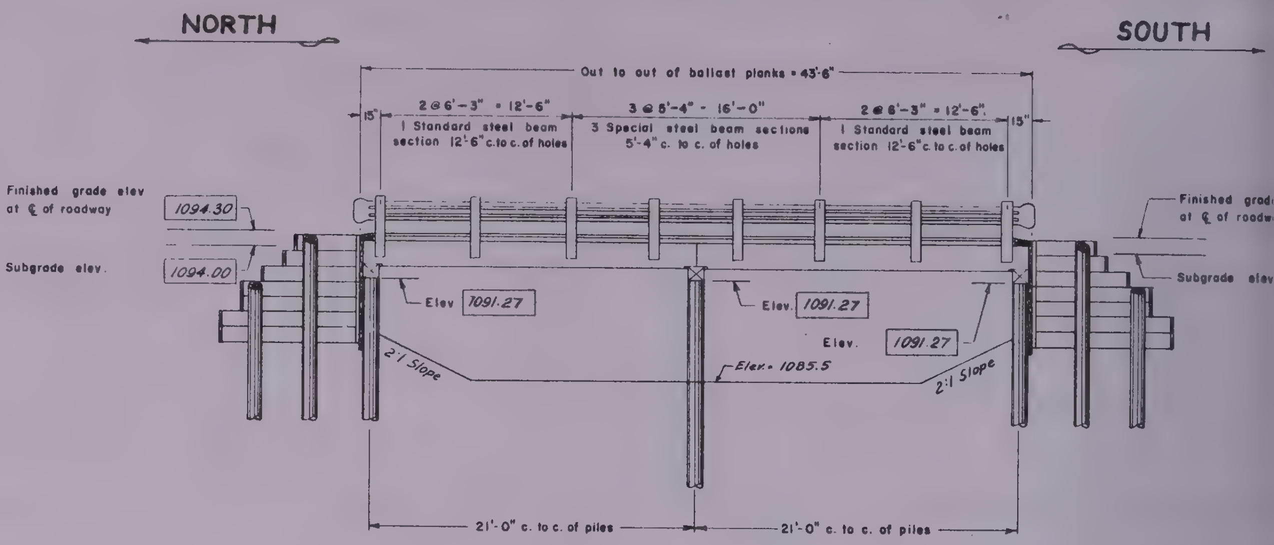




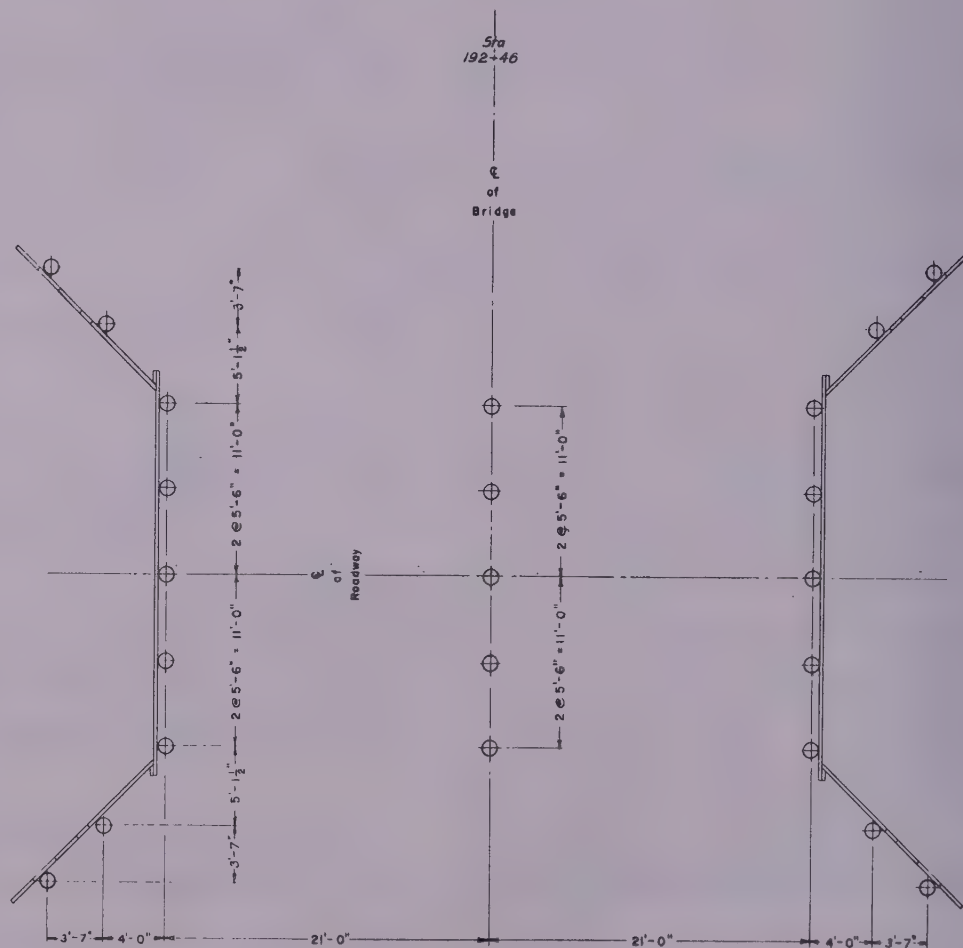
GENERAL NOTES

1.) Ends of all stringers must be cut square and true.
2.) The depth of the ends of all stringers shall be exact as indicated on this sheet. The depth of the dap shall vary according to the depth of the rough stringer but shall be more than 2" and not more than 3" deep. Daps and ends of all stringers shall be cut square.
3.) All timber listed herein shall be framed before treatment and shall conform to "Specifications for green timber and piles for preservative treatment" as set forth on form P.W.H.B.28.
Treatment of all timber listed herein shall conform to "Specifications for the preservative treatment of structural timber and piling with creosote oil by the pressure process" as set forth on form P.W.H.B.27.
4.) All timber shall be supplied conforming to the "Standard grading and dressing rules for lumber" as per specifications of British Columbia Lumber Manufacturers Association NO. 56

ST'D. T. S. 301	FRAMING DETAILS
REVISIONS	FOR TREATED TIMBER BRIDGE E. OF SEC. 15-3-10E. FROM P.T.H. NO. 12 TO WOODRIDGE STA. 192+ PINEY DISORGANIZED PROVINCE OF MANITOBA HIGHWAYS BRANCH BRIDGE ENGINEER'S OFFICE. DEPARTMENT OF PUBLIC WORKS
ST'D. APPROVED [signature] CHIEF ENGINEER MARCH 1957	Designed By H.E.C. Drawn By W.B. Traced By K.A. Engineer In Charge ... Checked By H.E.C. & I.S. Approved By [signature] BRIDGE ENGINEER [signature] CHIEF ENGINEER Date June 1957 SCALE SHEET NO. 2/3 PLAN NO. 2885



ELEVATION



PLAN

74.30

74.00

BILL OF PILES

15 Abutment piles =	25'-0"	375 lin. ft.
8 Wing piles =	20'-0"	160 lin. ft.
	Total =	535 lin. ft.

STEEL BEAM GUARD RAILING

PLAN NO 2885

MK	NO.	DESCRIPTION	REMARKS
	4	Standard sections	12'-6" c to c. of holes
	6	Special sections	5'-4" c to c. of holes
	4	Flared ends	
	72	$\frac{5}{8}$"ϕ x $1\frac{1}{4}$" bolts	Galvanized
	16	$\frac{5}{8}$"ϕ x 9" bolts	do
			Approx. weight = 714 lbs.

BILL OF TIMBER

PLAN NO 2885

MK	NO	DESCRIPTION	SIZE	LENGTH	REMARKS	Exact f.b.m
A_2	18	Stringers	6"x20"	22'-0"	See ST'D. T.S. 301	3,960
A_7	4	do	do	21'-6"	do	860
A_8	4	do	do	21'-6"	do	860
B_1	2	Caps	12" x 12"	26'-0"	do	624
B_2	1	do	do	26'-0"	do	312
D_2	4	Battens	3"x10"	7'-0"	do	70
E_1	2	End floor planks	3"x10"	12'-0"	do	60
E_2	2	do	do	14'-0"	do	70
E_7	2	do	do	9'-0"	Straight planks	45
E_8	2	do	do	17'-0"	do	85
F_1	4	Wing planks	3"x12"	6'-0"	See ST'D. T.S.301	72
F_2	4	do	do	7'-0"	do	84
F_3	4	do	do	9'-0"	do	108
F_4	8	do	do	11'-0"	do	264
F_5	8	do	do	13'-0"	do	312
~~F_6~~		~~do~~	~~do~~		~~do~~	
~~G_2~~	~~2~~	~~Sway braces~~	~~3"x10"~~	~~24'-0"~~	~~Straight planks~~	~~120~~
~~G_3~~	~~4~~	~~do~~	~~do~~		~~do~~	
H_1	6	Stringerstraps	4"x6"	24"	See ST'D. T.S. 301	24
K_1	16	Railposts	8"x8"	4'-0"	S4S do	341
L_1	10	Clamps	4"x6"	3'-0"	See ST'D. T.S. 301	60
L_2	10	do	do	4'-0"	do	80
M_1	4	Pile struts	4"x8"	5'-0"	do	53
	14	Ballast planks	3"x12"	26'-0"	Straight planks	1,092
	315	Decking	2"x4"	8'-0"	S4S do	1,680
	330	Decking incl. fascia				
		& edge screed	do	16'-0"	S4S do	3,320
					Total f.b.m. =	14,636

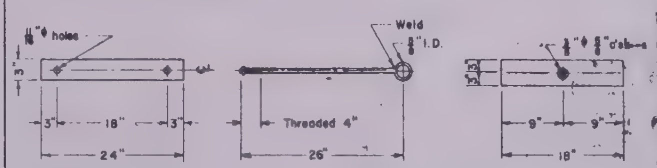
Timber to be "rough" unless otherwise noted in bill

BILL OF BRIDGE IRON

PLAN NO. 2885

MK	NO	DESCRIPTION	SIZE	LENGTH	LOCATION	WT.
Q_2	15	Drift bolts	$\frac{3}{4}$"ϕ	20"	Caps to piles	38
Q_3	29	do	$\frac{1}{2}$"ϕ	24"	Stringers to caps	39
Q_4	6	do	do	12"	Stringerstraps to caps	4
R_2	20	Machine bolts	$\frac{3}{4}$"ϕ	26"	Clamps to piles & caps	69
~~R_3~~	~~11~~	~~do~~	~~do~~	~~22"~~	~~Braces to piles & caps~~	~~33~~
R_4	64	do	$\frac{5}{8}$"ϕ	16"	Railposts to stringers	96
R_5	10	do	do	14"	Straps to piles & caps	13
R_6	9	do	$\frac{1}{2}$"ϕ	14"	Through stringers	7
R_7	4	do	do	12"	Stringer to one strap	3
R_8	4	do	do	16"	Stringer to two straps	4
R_9	8	do	do	8"	Battens to ballast planks	4
S_1	6	Eye bolts	$\frac{1}{2}$"ϕ	26"	Stringers to caps & struts	10
T_1	40	C.I. (O.G.) washers	For $\frac{3}{4}$"ϕ bolts		2 to bolts R_2 & R_3	40
T_2	146	do	For $\frac{5}{8}$"ϕ bolts		do R_4, 1 to screw Z_1	
					& 1 per steel beam bolt	85
T_3	6	do	For $\frac{1}{2}$"ϕ bolts		1 to bolts S_1	[illegible]
U_1	50	Cut washers	For $\frac{1}{2}$"ϕ bolts		2 to bolts R_6,R_7,R_8,& R_9	2
V_1	10	Pile straps	3"x$\frac{1}{4}$"	24"	Caps to piles, inter. bent	[illegible]
W_1	2	Steel plates	1"x6"	18"	Under int. butt joints	61
X_1	15	Galv. sheet pile caps	26 ga	15"x15"	Over piles under caps	18
Y_1		Common wire nails		8"	Steel plates to caps	1
Y_2		do		6"	Ballastwalls, wingwalls	
					& end floor planks	37
Y_3		do		5"	Battens	4
Y_4		do		$3\frac{1}{2}$"	Decking, fascia, edge screed,	
					fillers & galv. cap	215
Z_1	2	Lag screws	$\frac{5}{8}$"ϕ	10"	Pile struts to caps	2
					Total wt. =	808

Bolts R_4,R_5,R_6,R_7,R_8 & R_9 to be threaded $2\frac{1}{2}$"
Bolts R_2 & R_3 to be threaded 4"



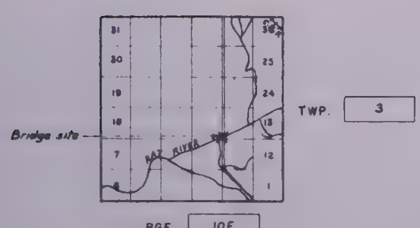
PILE STRAP MK."V_1"
$\frac{1}{4}$" Thick

EYE BOLT "S_1"
$\frac{1}{2}$"ϕ

STEEL PLATE MK."W_1"
1" Thick

SHEET LEGEND

1. General Elevation T.S. 314
2. Framing Details T.S. 301
3. Assembly Details T.S. 309



LOCATION PLAN

ST'D. T.S. 314

ST'D. APPROVED [signature]
CHIEF ENGINEER

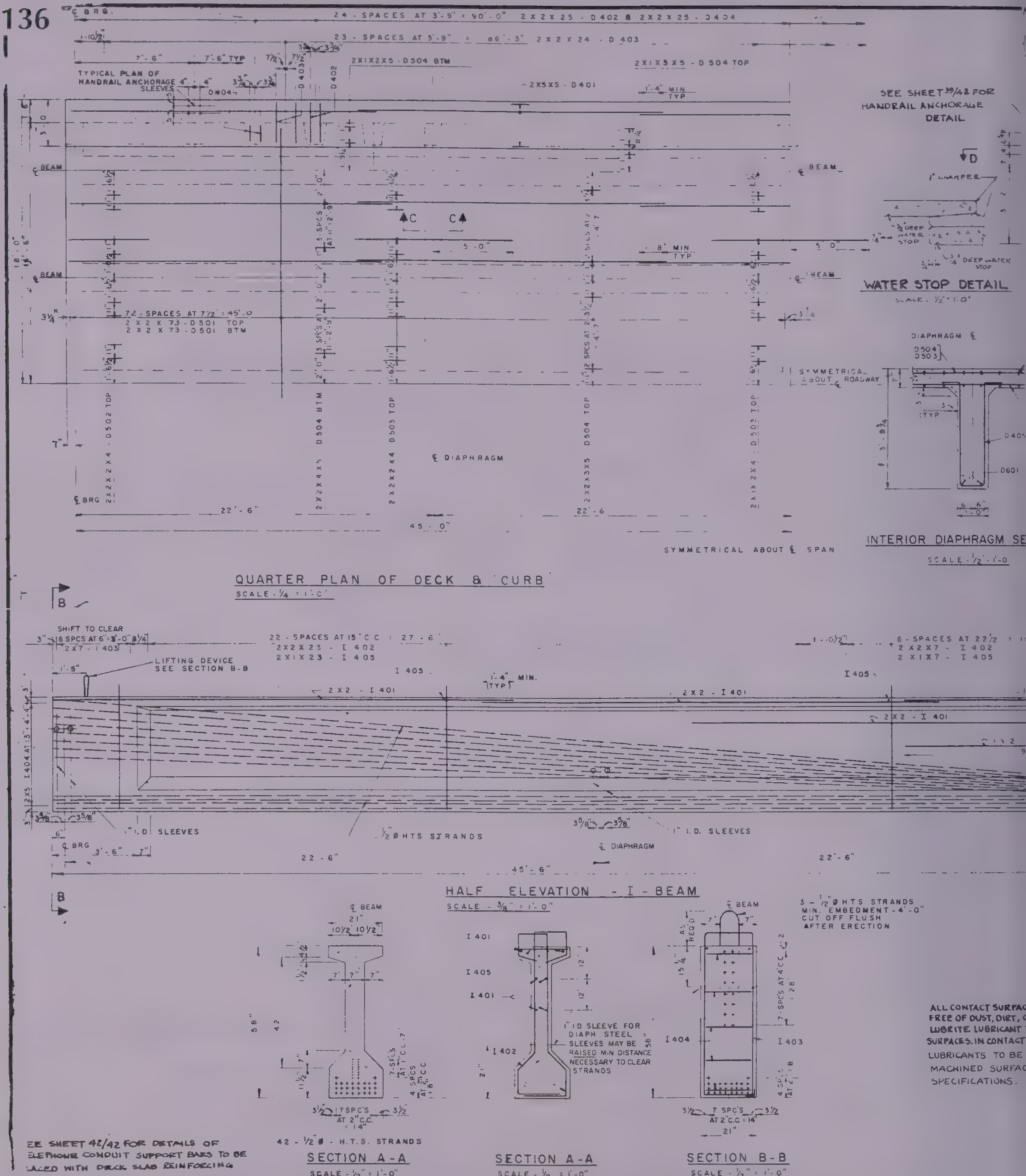
JUNE 1957

GENERAL ELEVATION

FOR 43'-6" TREATED TIMBER BRIDGE
LOADING H20 S16 24'-0" ROADWAY
E. OF SEC. 15-3-10E
FROM P.T.H. NO. 12 TO WOODRIDGE STA. 192+46
PINEY DISORGANIZED

PROVINCE OF MANITOBA
HIGHWAYS BRANCH BRIDGE ENGINEER'S OFFICE
DEPARTMENT OF PUBLIC WORKS

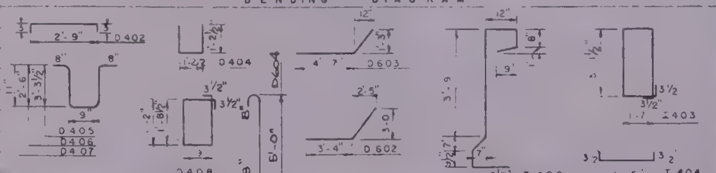
Designed By   Drawn By R.R.L.   Traced By R.R.L.
Engineer In Charge   Checked By W.B. & I.G.
Approved By [signature] BRIDGE ENGINEER   [signature] CHIEF ENGINEER
Date June 1957
SCALE $\frac{3}{16}$" = 1'-0" SHEET NO. [illegible] PLAN NO. 2885



BILL OF REINFORCING STEEL (FOR ONE SPAN)

STRAIGHT BARS				BENT BARS			
MK	NO	LENGTH	WT.	MK	NO	LENGTH	WT
D401	50	19'-4"	646	D402	100	3'-2"	212
D403	96	2'-9"	177	D404	100	3'-6"	234
D501	584	17'-3"	10,508	D405	60	8'-6"	341
D502	32	5'-0"	167	D406	6	6'-11"	28
D503	48	10'-0"	501	D407	6	3'-9"	15
D504	190	19'-8"	3,898	D408	44	5'-2"	152
D601	30	9'-9"	440	D409	4	4'-1"	11
				D602	12	7'-1"	28
I401	80	19'-3"	1,029	D603	8	6'-2"	75
I405	300	1'-7"	318	D604	16	6'-4"	152
				I402	600	9'-2"	3,674
				I403	70	13'-10"	647

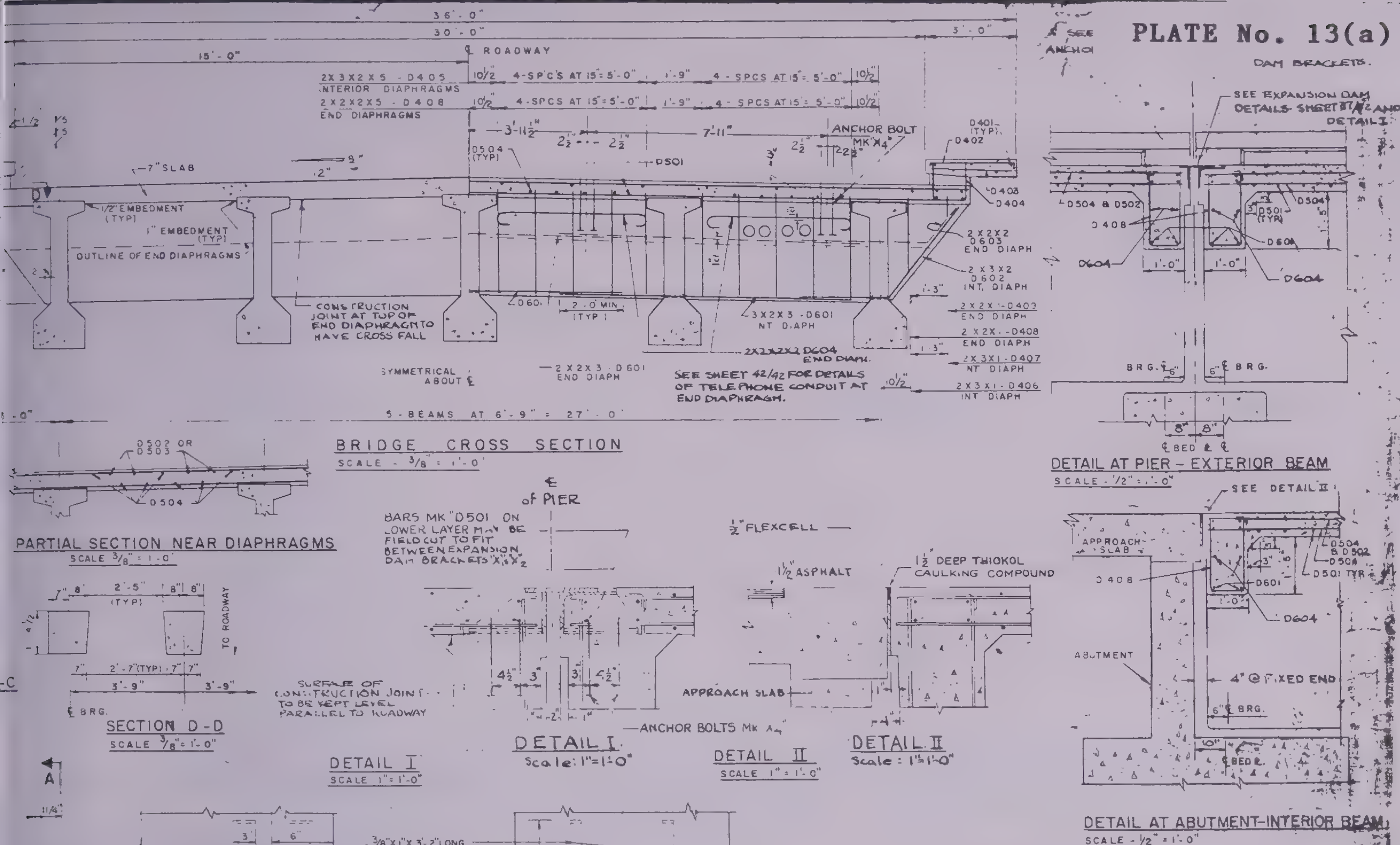
BENDING DIAGRAM

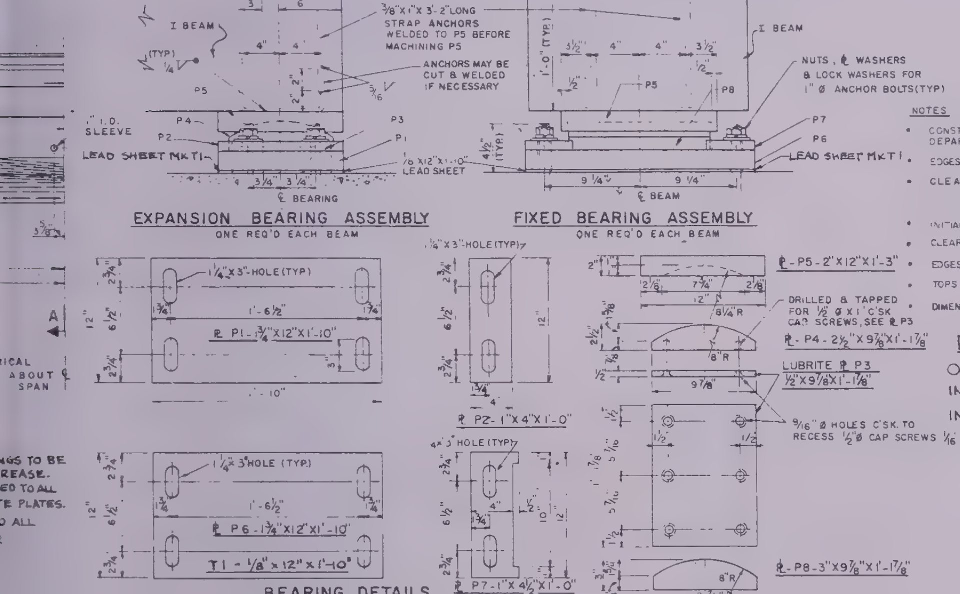


NOTES:
1. ALL DIMENSIONS GIVEN ARE OUT TO OUT
2. ALL REINFORCING STEEL SHALL BE INTERMEDIATE GRADE IN ACCORDANCE WITH ASTM SPECIFICATION A15-58T AND SHALL BE DEFORMED IN ACCORDANCE WITH A.S.T.M. SPECIFICATION A305-56T
3. LIKE BARS SHALL BE BUNDLED, SECURELY TIED AND IDENTIFIED AS TO MARK AND PLAN NUMBER BY STAMPED METAL TAGS. ALL OTHER ITEMS TO BE IDENTIFIED IN SIMILAR FASHION

Q
CONCRETE IN
CONCRETE IN
REINFORCING S
HANDRAIL ANCHO
BEARING ASSEMBL
CONCRETE IN I B
REINFORCING S
HIGH TENSILE ST
1" I D SLEEVES
1" I D SLEEVES
AREA OF RUB FINI

PLATE No. 13(a)





BEARING DETAILS
SUPPLIED BY MINISTER
SCALE 1½" = 1'-0"

NOTES

- CONSTRUCTION SHALL BE IN ACCORDANCE WITH CURRENT DEPARTMENT OF PUBLIC WORKS SPECIFICATIONS
- EDGES OF CAST IN SITU CONCRETE SHALL BE CHAMFERED ¾"
- CLEAR COVER TO REINFORCING STEEL FOR CAST IN SITU CONCRETE:- TOP OF DECK = 1¼" - REMAINDER OF DECK & CURBS = 1" MIN. DIAPHRAGMS = 1½" MIN.
- INITIAL FORCE IN EACH H.T.S. STRAND - 25,200 LBS.
- CLEAR COVER TO REINFORCING STEEL FOR PRECAST BEAMS - 1" MIN.
- EDGES OF PRECAST BEAMS SHALL BE ROUNDED TO ¾" RADIUS.
- TOPS OF PRECAST BEAMS SHALL BE THOROUGHLY ROUGHENED.
- DIMENSIONAL TOLERANCES:- LENGTH ± ¼" CROSS SECTION ± [illegible]

RUB FINISHED CONCRETE

OUTER FACE OF CURB SLAB	96.9 SQ.FT.
INNER FACE OF CURB SLAB	76.0 SQ.FT.
INNER FACE OF CURB BLOCKS	23.9 SQ.FT.
TOTAL	196.8 SQ.FT.

N. E. DAMAS — REGISTERED ENGINEER — PROVINCE OF MANITOBA
B. F. DOWSLEY — REGISTERED ENGINEER — PROVINCE OF MANITOBA
DAMAS AND SMITH LIMITED

...IES (FOR ONE SPAN)		TOTAL Q'TIES FOR 7 SPANS	
...DIAPHRAGMS	75.67 CU.YDS	529.69	cu.yds.
...2 X 5.75	11.50 CU.YDS	80.5	cu.yds.
...DECK, DIAPH. & CURBS	17685 LBS	123795	lbs.
...NITS	26 EACH	182	units
	3,498 LBS.	24,486	lbs
...TS 5 X 17.14	85.70 CU.YDS	599.9	cu.yds.
...BEAM UNITS	5,738 LBS.	40166	lbs.
..." DIA 19,410 LIN. FT.	9,589 LBS.	67123	lbs.
...MS - 0'-7" LONG	30 EACH	210	
...MS - 1'-9" LONG	20 EACH	140	
...CRETE	196.8 SQ.FT.	1,377.6	sq.ft.
...T	34.71 TONS		

REINFORCING STEEL TOTALS FOR 7 SPANS			
MK.	NO	MK.	NO
D401	350	D402	700
D403	672	D404	700
D501	4088	D405	420
D502	224	D406	42
D503	336	D407	42
D504	1330	D408	308
D601	210	D409	28
		D602	84
I401	560	D603	56
I405	2100	D604	112
		I402	4200
		I403	490
		I404	350

REVISIONS

TYPE 1

ST'D. P.P. 108 B

APPROVED: ....
CHIEF BRIDGE ENGINEER

PRECAST PRESTRESSED CONCRETE I-BEAM 90'-0" SPAN

Pretensioned Straight Strands., Pretensioned Draped Strands

FOR 806'-10" BRIDGE 30'-0" ROADWAY
OVER RED RIVER FLOODWAY P.T.H. NO. 4E
THROUGH LOTS 158-161 PARISH OF ST. ANDREWS

R.M. OF ST. CLEMENTS

PROVINCE OF MANITOBA
HIGHWAYS BRANCH BRIDGE ENGINEER'S OFFICE
DEPARTMENT OF PUBLIC WORKS

Designed by .... Drawn by .... Traced by ....
Design checked by .... Drawing checked by ....
Approved by .... CHIEF BRIDGE ENGINEER
Date .... Sheet No. 34/42
Scale AS SHOWN

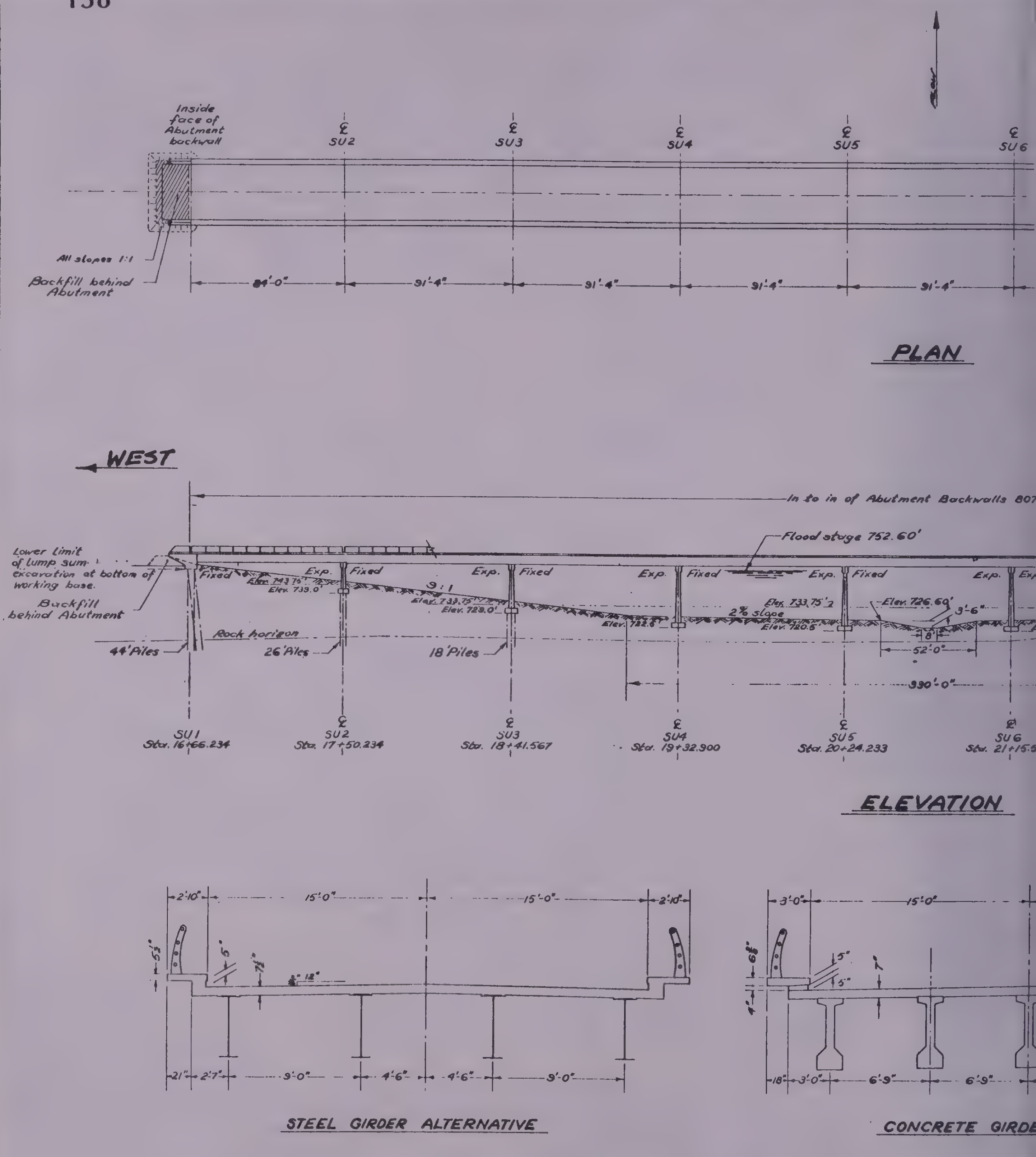
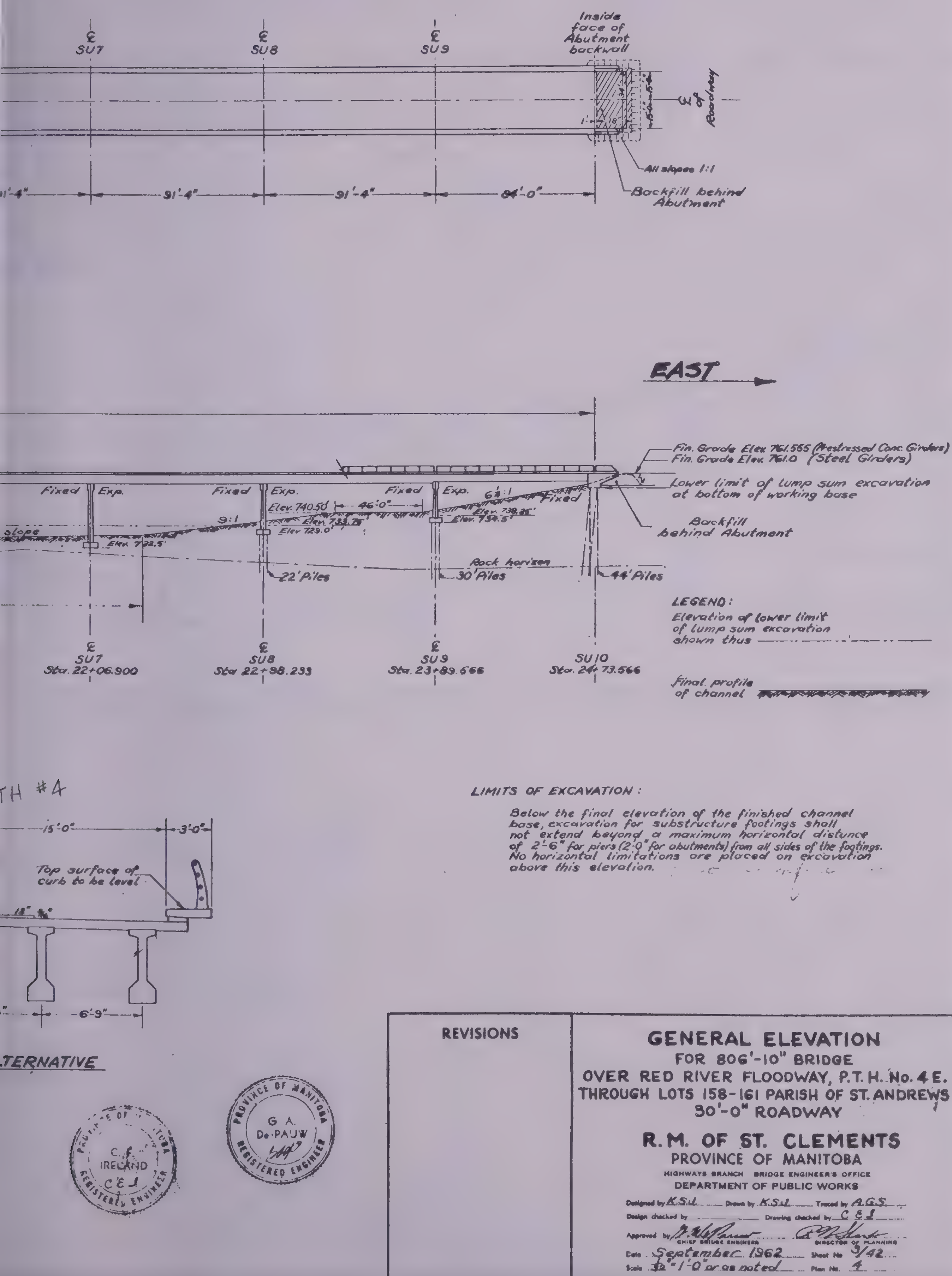
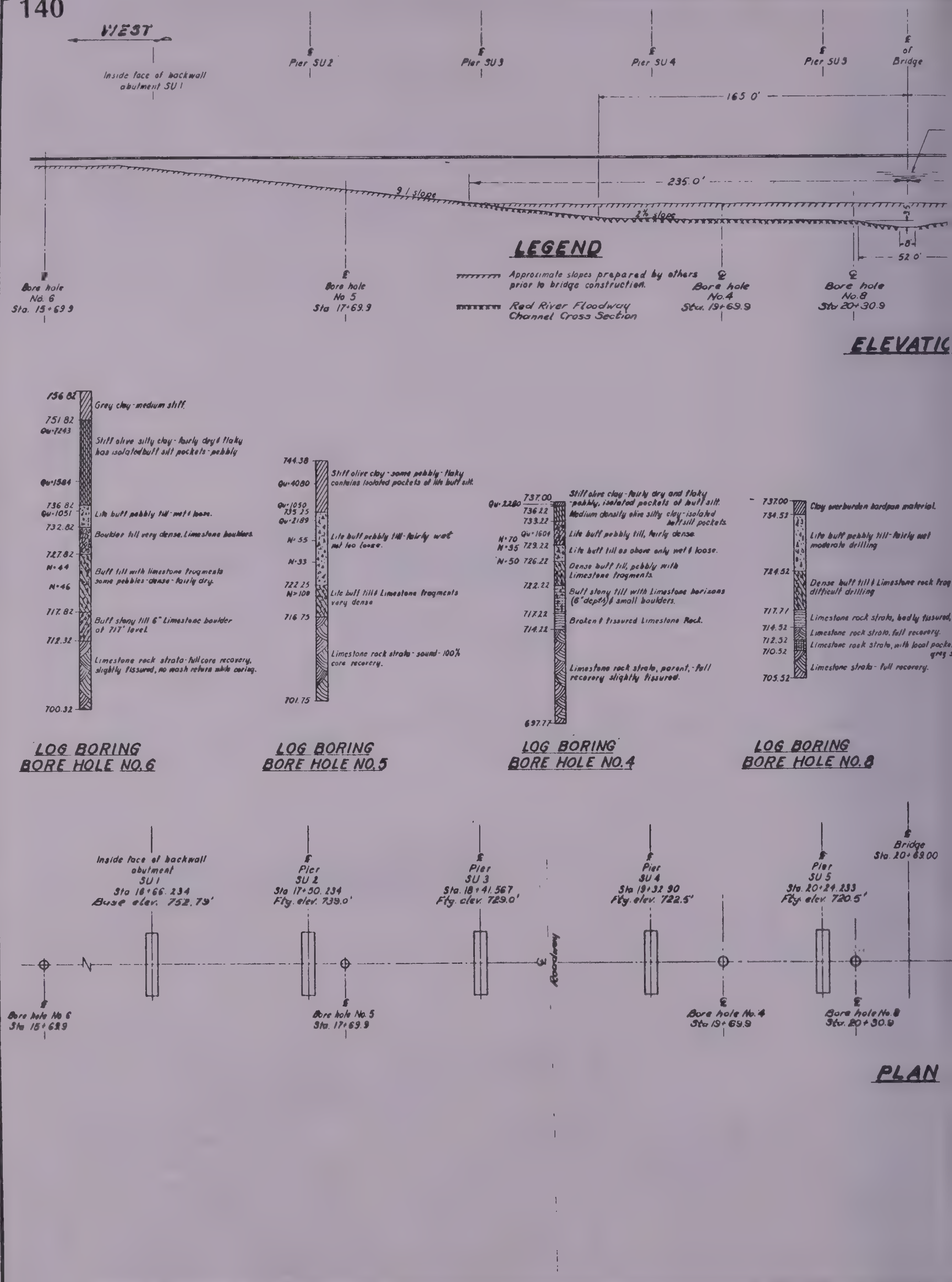
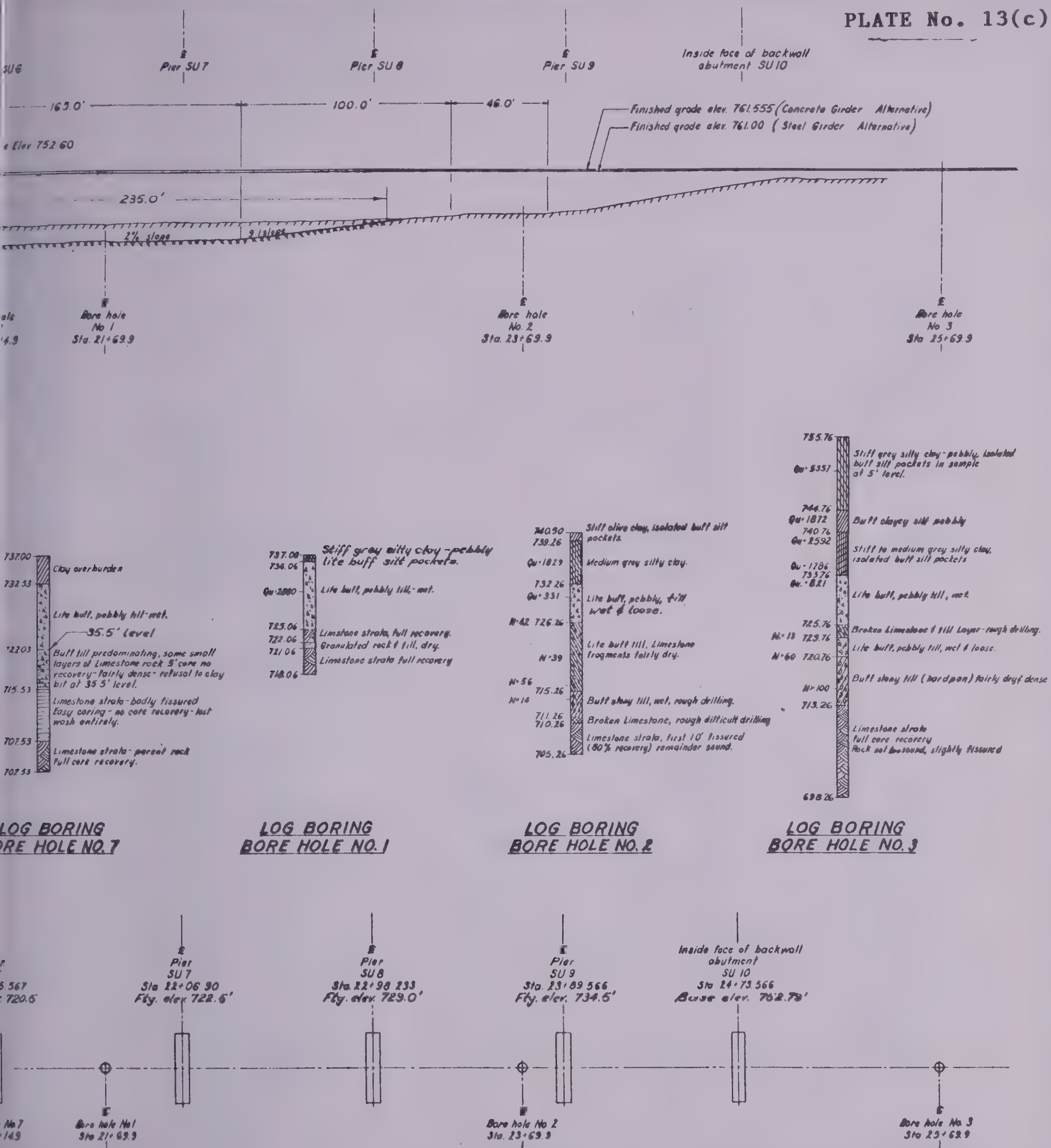

Inside face of Abutment backwall
SU2
SU3
SU4
SU5
SU6
All slopes 1:1
Backfill behind Abutment
84'-0"
91'-4"
91'-4"
91'-4"
91'-4"
91'-4"
PLAN
WEST
In to in of Abutment Backwalls 807
Flood stage 752.60'
Lower limit of lump sum excavation at bottom of working base.
Backfill behind Abutment
Fixed
Exp.
Fixed
Exp.
Fixed
Exp.
Fixed
Exp.
Fixed
Exp.
9:1
Elev. 739.0'
Elev. 733.75'
Elev. 728.0'
Elev. 722.5'
Elev. 733.75'
2% slope
Elev. 720.5'
Elev. 726.60'
3'-6"
8'
52'-0"
330'-0"
Rock horizon
44' Piles
26' Piles
18' Piles
SU1 Sta. 16+66.234
SU2 Sta. 17+50.234
SU3 Sta. 18+41.567
SU4 Sta. 19+32.900
SU5 Sta. 20+24.233
SU6 Sta. 21+15.5
ELEVATION
2'-10"
15'-0"
15'-0"
2'-10"
5½"
5"
7½"
12"
21"
2'-7"
9'-0"
4'-6"
4'-6"
9'-0"
STEEL GIRDER ALTERNATIVE
3'-0"
15'-0"
6⅞"
5"
5"
7"
4"
18"
3'-0"
6'-9"
6'-9"
CONCRETE GIRDE
TYPICAL CROSS SECTIONS
Scale: ¼" = 1'-0"

PLATE No. 13(b)



Inside face of Abutment backwall
℄ SU7
℄ SU8
℄ SU9
℄ of Roadway
All slopes 1:1
Backfill behind Abutment
91'-4"
91'-4"
84'-0"
EAST
Fin. Grade Elev. 761.555 (Prestressed Conc. Girders)
Fin. Grade Elev. 761.0 (Steel Girders)
Lower limit of lump sum excavation at bottom of working base
Backfill behind Abutment
Fixed
Exp.
Fixed
Exp.
Fixed
Exp.
Fixed
Elev. 740.50
46'-0"
9:1
Slope
Elev. 722.5'
Elev. 729.0'
Elev. 738.25'
Rock horizon
22' Piles
30' Piles
44' Piles
LEGEND:
Elevation of lower limit of lump sum excavation shown thus
Final profile of channel
℄ SU7 Sta. 22+06.900
℄ SU8 Sta. 22+98.233
℄ SU9 Sta. 23+89.566
SU10 Sta. 24+73.566
TH #4
15'-0"
3'-0"
Top surface of curb to be level
6'-9"
LTERNATIVE
LIMITS OF EXCAVATION:
Below the final elevation of the finished channel base, excavation for substructure footings shall not extend beyond a maximum horizontal distance of 2'-6" for piers (2'-0" for abutments) from all sides of the footings. No horizontal limitations are placed on excavation above this elevation.
PROVINCE OF MANITOBA C. E. IRELAND REGISTERED ENGINEER
PROVINCE OF MANITOBA G. A. De PAUW REGISTERED ENGINEER
REVISIONS
GENERAL ELEVATION
FOR 806'-10" BRIDGE
OVER RED RIVER FLOODWAY, P.T.H. No. 4 E.
THROUGH LOTS 158-161 PARISH OF ST. ANDREWS
30'-0" ROADWAY
R.M. OF ST. CLEMENTS
PROVINCE OF MANITOBA
HIGHWAYS BRANCH BRIDGE ENGINEER'S OFFICE
DEPARTMENT OF PUBLIC WORKS
Designed by K.S.J. Drawn by K.S.J. Traced by A.G.S.
Drawing checked by C.E.I.
CHIEF BRIDGE ENGINEER
DIRECTOR OF PLANNING
Date September 1962 Sheet No. 3/42
Scale 1/32"=1'-0" or as noted Plan No. 4


WEST
Inside face of backwall abutment SU 1
℄ Pier SU 2
℄ Pier SU 3
℄ Pier SU 4
℄ Pier SU 5
℄ of Bridge
165.0'
235.0'
9:1 slope
2% slope
8'
52.0'
LEGEND
Approximate slopes prepared by others prior to bridge construction.
Red River Floodway Channel Cross Section
℄ Bore hole No. 6 Sta. 15+69.9
℄ Bore hole No 5 Sta 17+69.9
℄ Bore hole No. 4 Sta. 19+69.9
℄ Bore hole No. 8 Sta 20+30.9
ELEVATIC
756.82 Grey clay - medium stiff
751.82 Qu-7243 Stiff olive silty clay - fairly dry & flaky has isolated buff silt pockets - pebbly
Qu-1584
736.82 Qu-1051 Lite buff pebbly till - wet & loose.
732.82 Boulder till very dense. Limestone boulders.
727.82 N-44 N-46 Buff till with limestone fragments some pebbles - dense - fairly dry.
717.82 Buff stony till 6" Limestone boulder at 717' level.
712.32 Limestone rock strata - full core recovery, slightly fissured, no wash return while coring.
700.32
LOG BORING
BORE HOLE NO. 6
744.38 Qu-4080 Stiff olive clay - some pebbly - flaky contains isolated pockets of lite buff silt.
Qu-1050 735.25 Qu-2189
N-55 N-33 Lite buff pebbly till - fairly wet not too loose.
722.25 N>100 Lite buff till & Limestone fragments very dense
716.75 Limestone rock strata - sound - 100% core recovery.
701.75
LOG BORING
BORE HOLE NO. 5
Qu-2280 737.00 Stiff olive clay - fairly dry and flaky - pebbly, isolated pockets of buff silt.
736.22 Medium density olive silty clay - isolated buff silt pockets.
733.22 Qu-1604 N-70 Lite buff pebbly till, fairly dense.
N-35 729.22 Lite buff till as above only wet & loose.
N-50 726.22 Dense buff till, pebbly with limestone fragments.
722.22 Buff stony till with Limestone horizons (6" depth) & small boulders.
717.22 Broken & fissured Limestone Rock.
714.22 Limestone rock strata, parent, - full recovery slightly fissured.
697.77
LOG BORING
BORE HOLE NO. 4
737.00 Clay overburden hardpan material.
734.52 Lite buff pebbly till - fairly wet moderate drilling
724.52 Dense buff till & Limestone rock frag difficult drilling
717.71 Limestone rock strata, badly fissured,
714.52 Limestone rock strata, full recovery.
712.52 710.52 Limestone rock strata, with local pocke grey s
Limestone strata - full recovery.
705.52
LOG BORING
BORE HOLE NO. 8
Inside face of backwall abutment SU 1 Sta 16+66.234 Base elev. 752.79'
℄ Pier SU 2 Sta 17+50.234 Ftg. elev. 739.0'
℄ Pier SU 3 Sta. 18+41.567 Ftg. elev. 729.0'
℄ Roadway
℄ Pier SU 4 Sta 19+32.90 Ftg. elev. 722.5'
℄ Pier SU 5 Sta. 20+24.233 Ftg. elev. 720.5'
℄ Bridge Sta. 20+69.00
℄ Bore hole No 6 Sta 15+69.9
℄ Bore hole No. 5 Sta. 17+69.9
℄ Bore hole No. 4 Sta 19+69.9
℄ Bore hole No. 8 Sta. 20+30.9
PLAN



NOTE:
Foundation data as shown in bore holes is primarily for design purposes, and the Department does not guarantee that the information is free from errors or discrepancies.

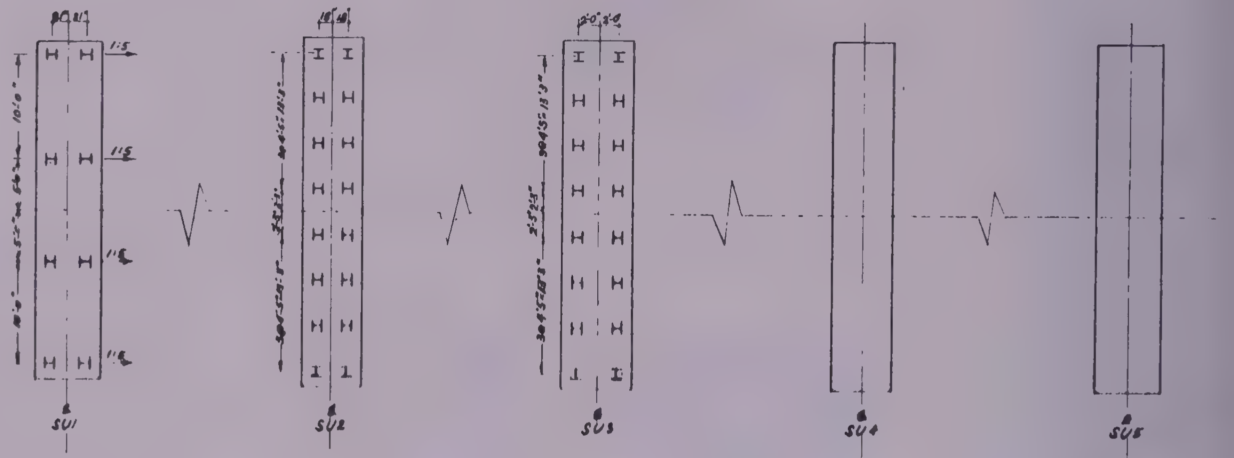
REVISIONS

Ground line revised as constructed. Nov. 28/62 C.E.J.

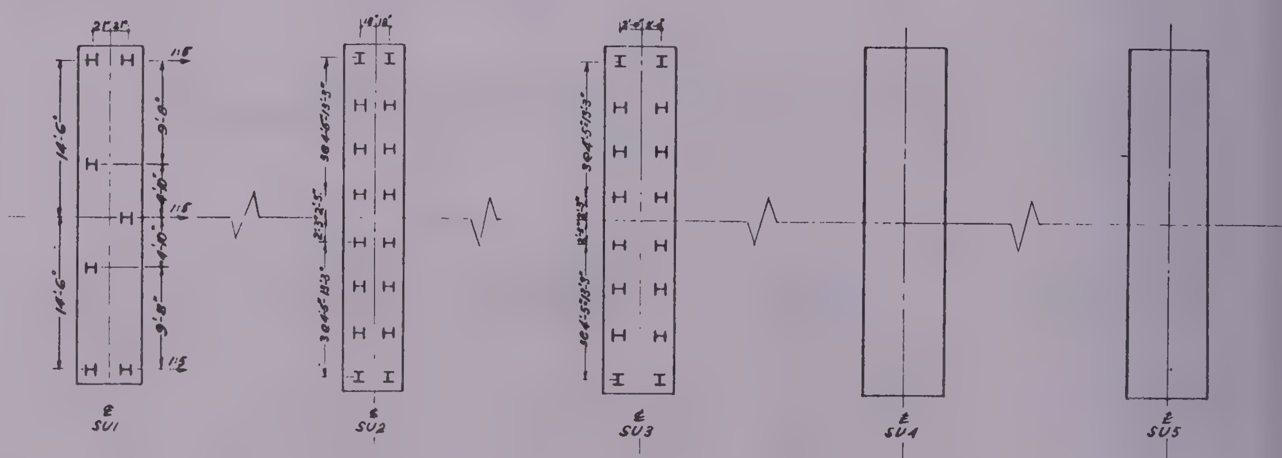
LOG BORING DETAILS
FOR 806'-10" BRIDGE
OVER RED RIVER FLOODWAY ON P.T.H. #4
THROUGH LOTS 158-161 PARISH OF ST. ANDREWS
30'-0" ROADWAY
R.M. OF ST. CLEMENTS

PROVINCE OF MANITOBA
HIGHWAYS BRANCH BRIDGE ENGINEER'S OFFICE
DEPARTMENT OF PUBLIC WORKS

Designed by ...... Drawn by D.A.E. Traced by L.M.
Design checked by ...... Drawing checked by C.E.J.
Approved by ...... CHIEF BRIDGE ENGINEER ...... DIRECTOR OF PLANNING
Date September 1962 Sheet No. 4/42
Scale 1" = 30'-0" Plan No. 4



PILE ARRANGEMENT



PILE ARRANGEMEN

Limits of Excavation.

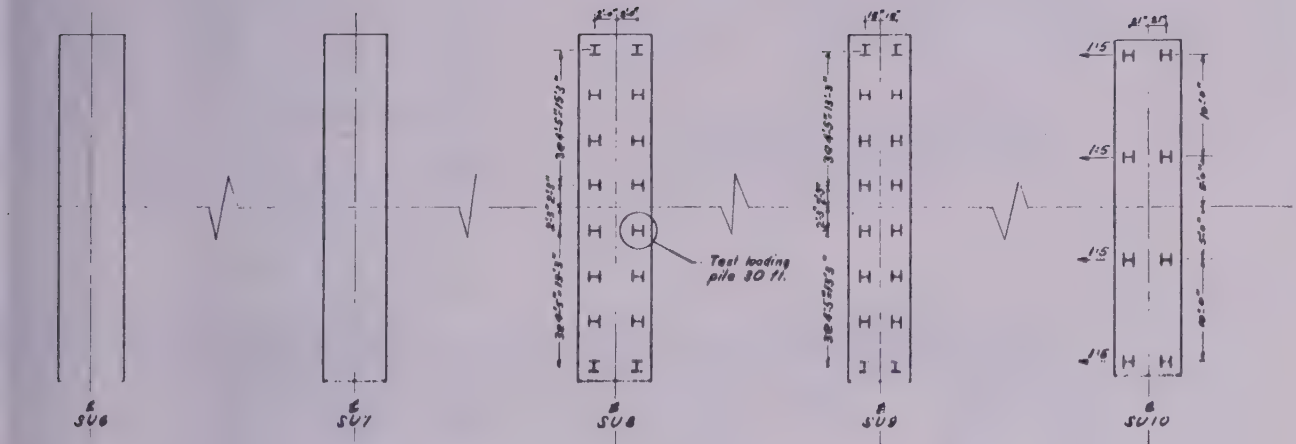
Below the final elevation of the finished channel base, excavation for substructure footings shall not extend beyond a maximum horizontal distance of 2'-6" for piers (2'-0" for abutments) from all sides of the footings. No limitations are placed on excavation above this elevation.

NOTE:

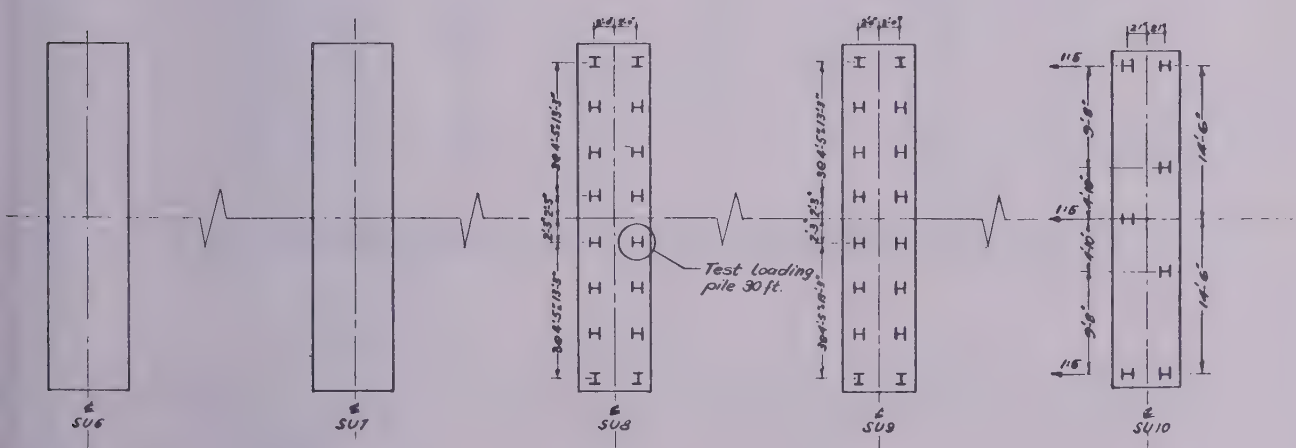
The Flange orientation of H-piles shall be as shown in plan.

BILL (			
	STEEL GIRDER A		
LOCATION	NO.	SIZE (IN)	WT/FT. (LB)
SU 1	7	10×10	57
SU 2	16	"	"
SU 3	16	"	"
SU 8	16	"	"
SU 9	16	"	"
SU 10	7	"	"

PLATE No. 13(d)



PRESTRESSED SUPERSTRUCTURE



FOR STEEL SUPERSTRUCTURE

STEEL H-PILES

...RNATIVE		CONCRETE GIRDER ALTERNATIVE				
...GTH (...)	TOTAL LENGTH(FT)	NO	SIZE (IN)	WT./FT (LB)	LENGTH (FT)	TOTAL LENGTH(FT)
	308	8	10x10	57	44	352
	416	16	"	"	26	416
	288	16	"	"	18	288
	352	16	"	"	22	352
	480	16	"	"	30	480
	308	8	"	"	44	352
...AL	2152				TOTAL	2240

REVISIONS

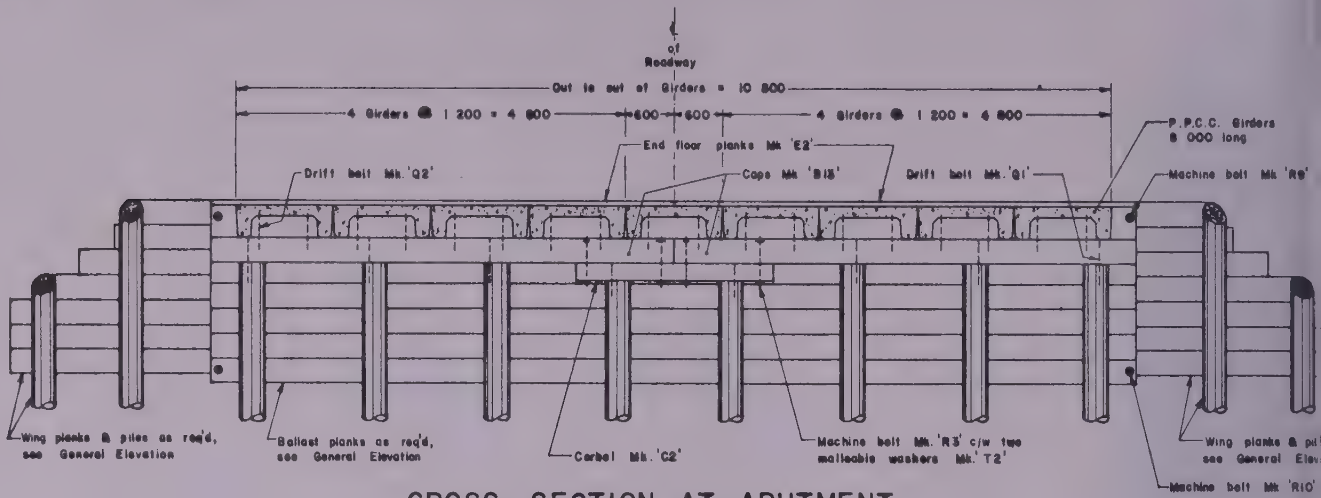
PILE LAYOUT

FOR 806'-10" BRIDGE
OVER RED RIVER FLOODWAY, P.T.H. No. 4E.
THROUGH LOTS 158-161 PARISH OF ST. ANDREWS
30'-0" ROADWAY

R.M. OF ST. CLEMENTS

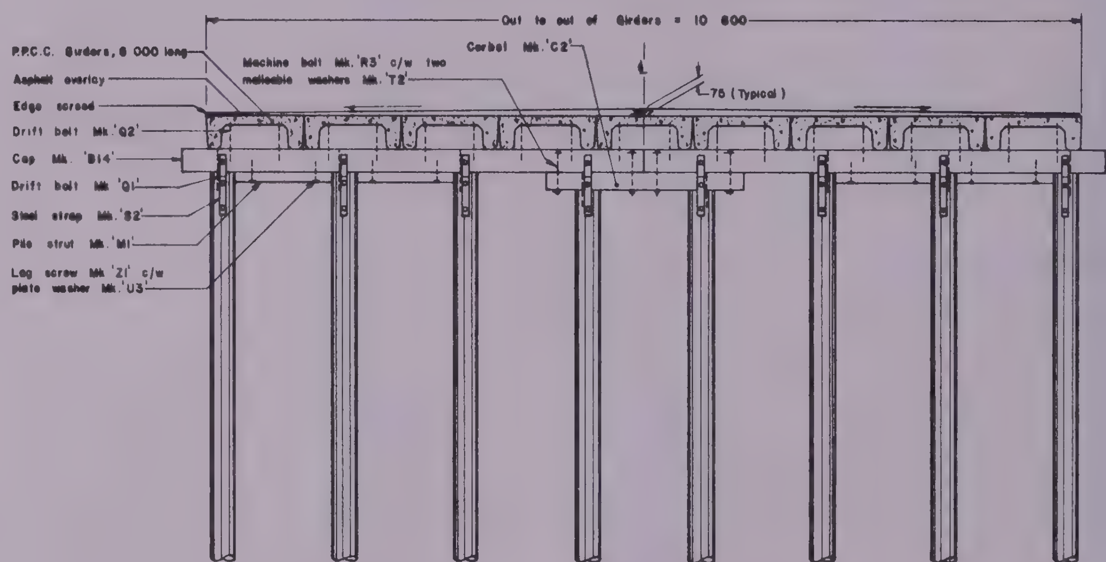
PROVINCE OF MANITOBA
HIGHWAYS BRANCH BRIDGE ENGINEER'S OFFICE
DEPARTMENT OF PUBLIC WORKS

Designed by K.S.J. Drawn by K.S.J. Traced by M.B.
Design checked by C.E.I. Drawing checked by SSS
Approved by [signature] CHIEF BRIDGE ENGINEER [signature] DIRECTOR OF PLANNING
Date August 1962 Sheet No 5/42
Scale 1/8"=1'-0" Plan No. 4

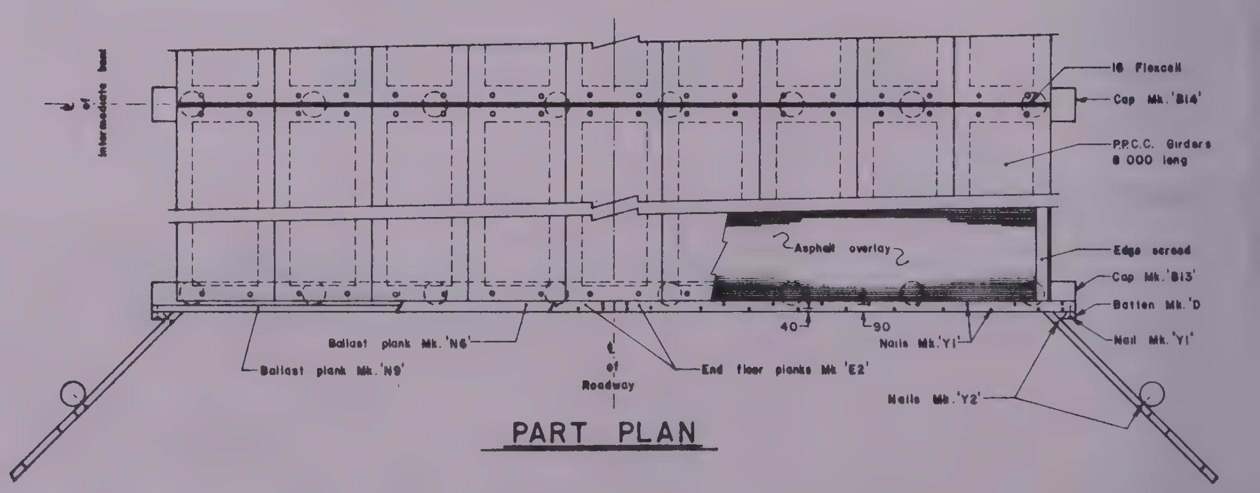


CROSS SECTION AT ABUTMENT

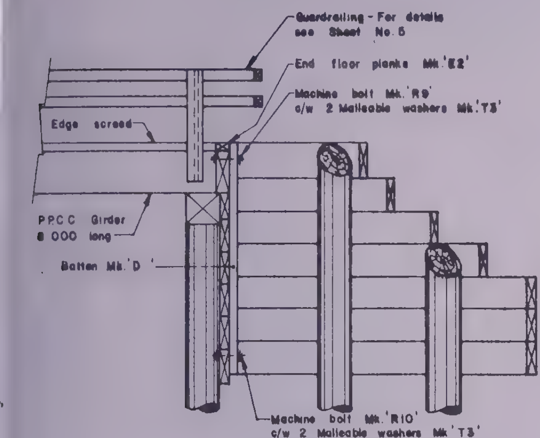
NOTE: Angle Mk. 'S1' and asphalt overlay not shown.



CROSS SECTION AT INTERMEDIATE BENT

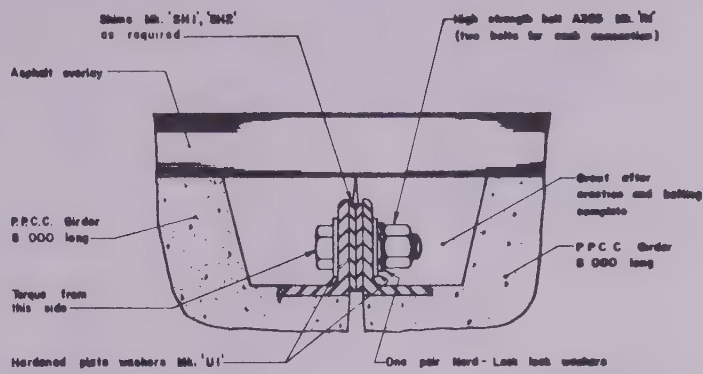


PART PLAN



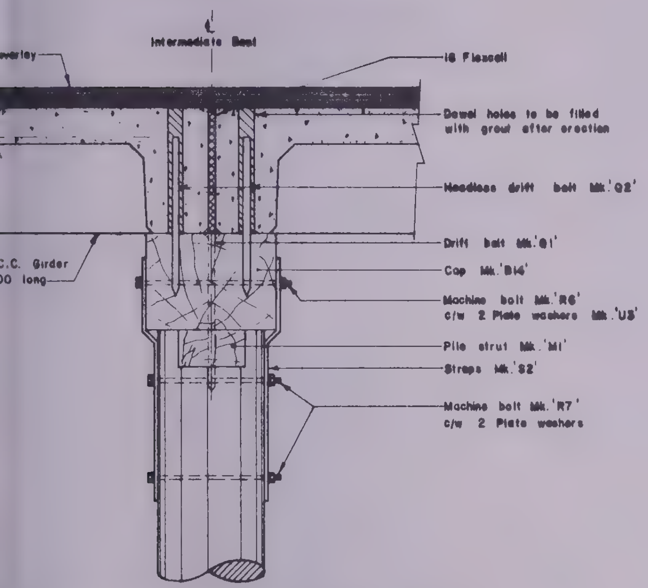
PART SIDE ELEVATION

Scale 1 : 30



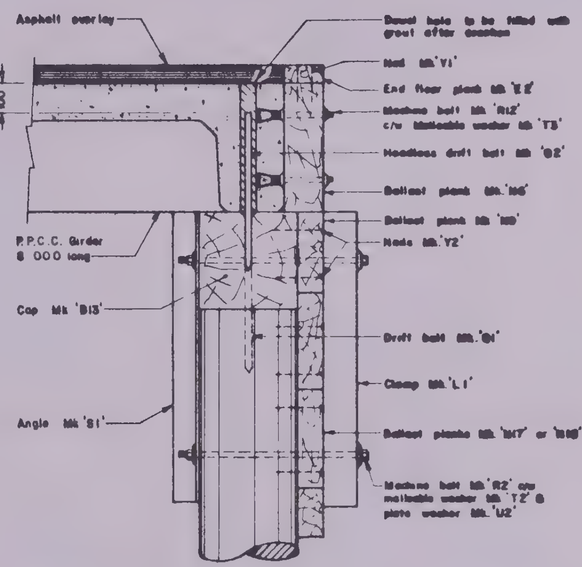
DETAIL OF GIRDER LATERAL CONNECTION

Scale 1 : 3



TION AT INTERMEDIATE BENT

Scale 1 : 10



SECTION AT ABUTMENT

Scale 1 10

NOTES

TIMBER FRAMING & ASSEMBLY

Cuts on piles and timber shall be given two coats of timber preservative.

All field bored holes shall be poured full of timber preservative before assembly.

Field drilled machine bolt holes to be bored 2 mm larger than bolt diameter. Drift bolt holes to be bored to bolt diameter.

Joints in edge screeds to be at ℄ of plates Mk.'V1'

NAILING SCHEDULE

Ballast Planks	Two nails Mk.'Y2' per plank Mk.'N17' & 'N18' per pile, equivalent at pile cap.
Wing Planks	: Two nails Mk.'Y2' per plank per pile, equivalent at inner end.
Battens	: Two nails Mk.'Y1' per ballast plank.
End Floor Planks	: Nails Mk.'Y1' staggered at 300 c/c; two nails at the ends.

REVISIONS		
DATE	BY	DESCRIPTION

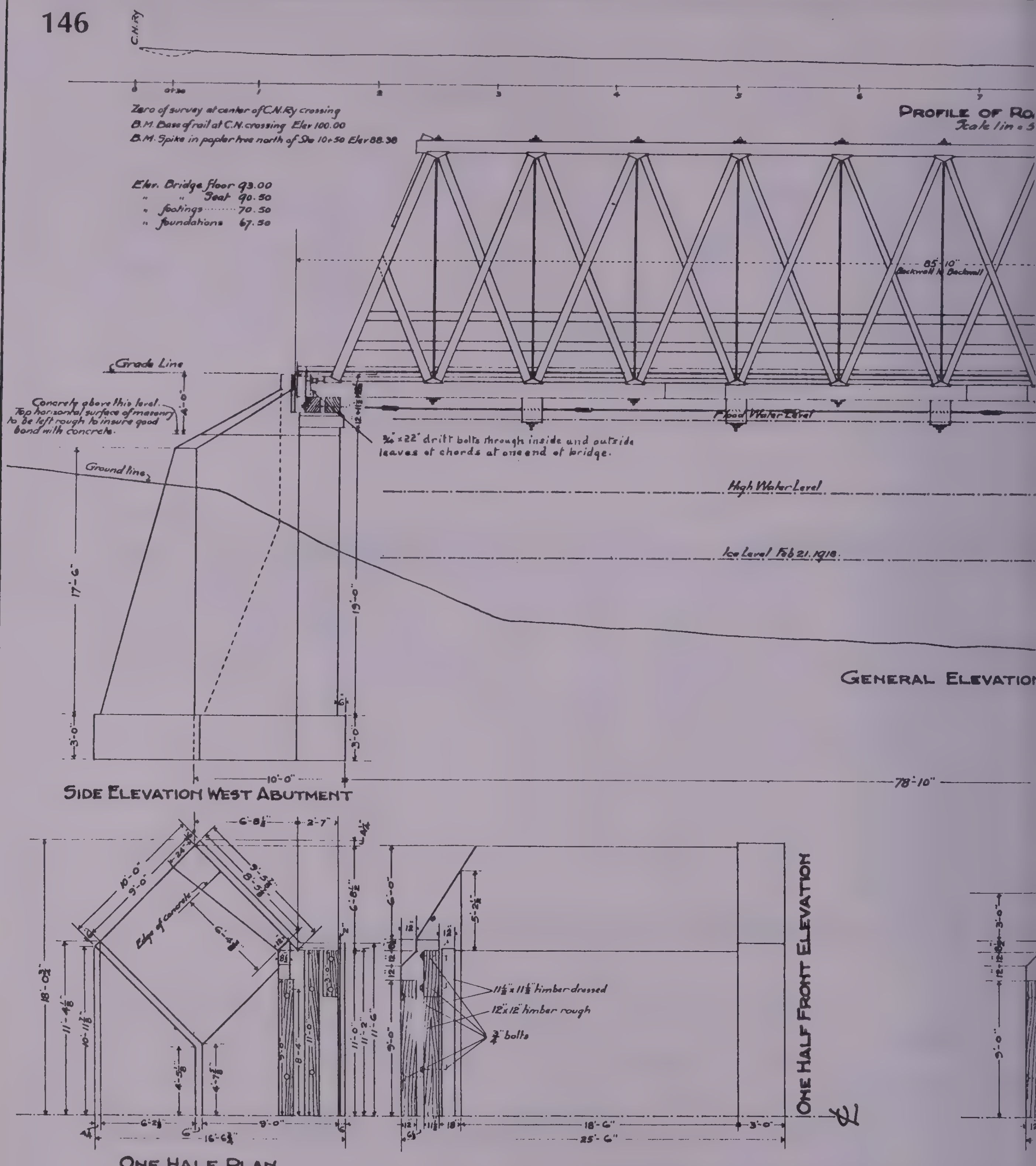
ST'D. P.C. 100
CHECKED BY
DATE
APPROVED BY
DIRECTOR OF BRIDGES
DATE: Jan. 7, 1988

ASSEMBLY DETAILS

Manitoba Highways and Transportation
Bridge Division

PROJECT ENGINEER		
DESIGN	BY:	
	CHECKED:	
DETAILS	BY:	
	TRACED:	
	CHECKED:	

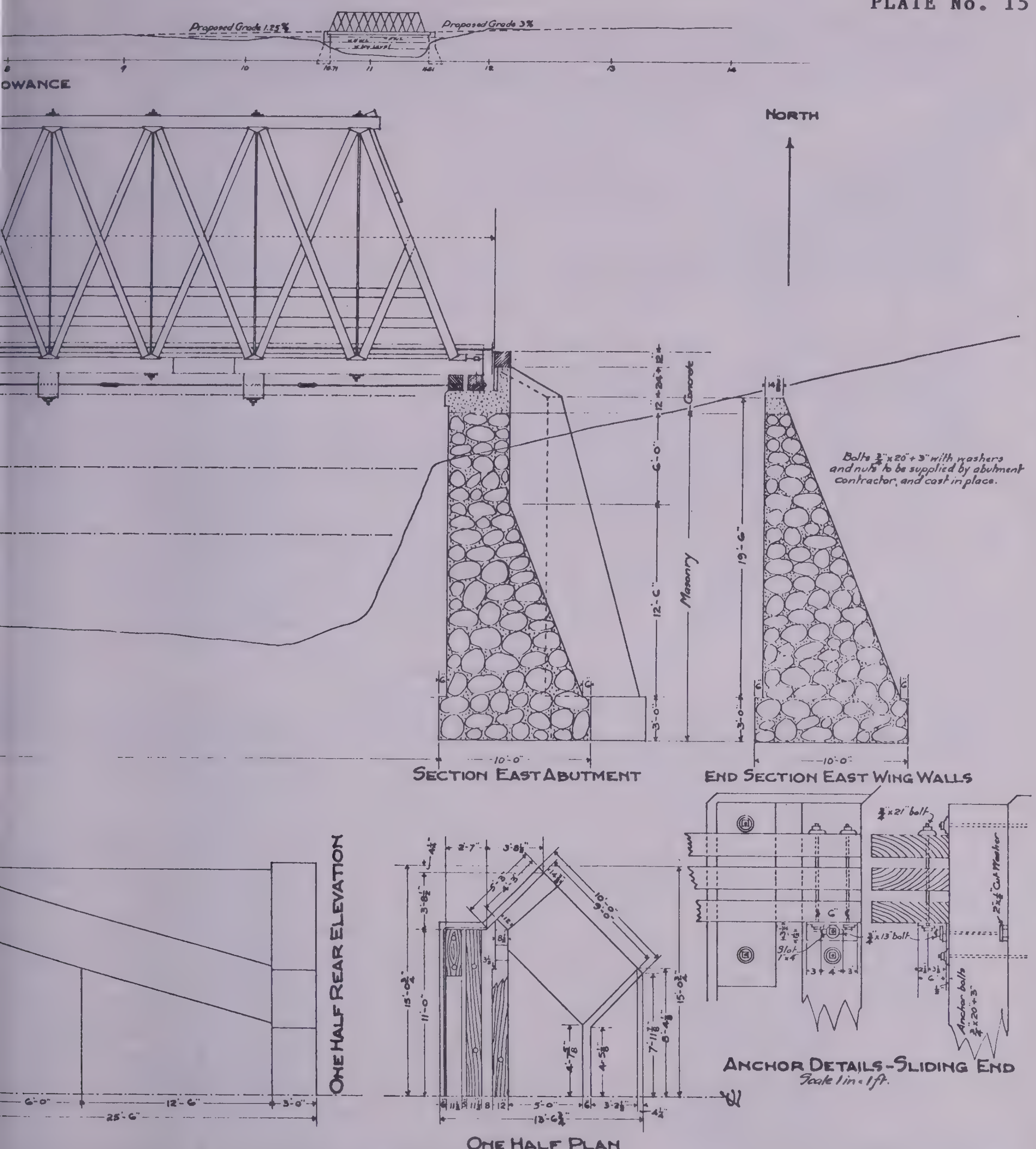
APPROVED BY:
EXECUTIVE DIRECTOR DATE
APPROVED BY:
DIRECTOR OF BRIDGES AND STRUCTURES DATE
SCALE: 1 : 10
SHEET No.
SITE No.



BILL OF MATERIAL NOT SHOWN ON STANDARD HOWE TRUSS P

TIMBER					IRON		
Description	No.	Dressed Size	Length	Remarks	Description	No.	Size
Ballast Wall Caps	2	12" x 12"	18'-0"	Rough	Anchor bolts	24	¾" x 20"+3"
Bolsters	4	11½" x 11½"	3'-0"		C.I Cup Washers	8	for ¾" bolts
End floor beams	2	11½" x 11½"	22'-0"		C.I. Ogee "	20	" ¾" "
Flooring	2	3" x 8"	18'-0"	Rough.	Drift bolts	18	⅝" x 20"
					" "	4	¾" x 22"
					Angles	2	6x3½x½xlength
					Bolts	4	¾" x 21"
					"	2	¾" x 13"
					Cut washers	6	2" x ¼"
					" "	2	2" x ½"

SET No.



narks
end floor beams to concrete
walls
Angles to chords
end floor beams
to end floor beams
rd to end floor beams
chord
end floor beam
angle
d floor beam

ITEMS SHOWN ON BILL OF MATERIAL ON STANDARD HOWE TRUSS PLAN TO BE CHANGED

Description	No	Size	Length	Remarks
Stringers	18	3 1/2 x 15 1/2	16'-0"	Length to be changed to 16'-8"
Guard rails	170 Lin ft	3 1/2 x 5 1/2		" " " " " 172 lineal ft.
Lag Screws	12	3/4"	10"	to be changed to bolts with nuts & washers 3/4" x 17 1/2. Portal strut to chord
" "	12	1/2"	8"	" " " " " " " " 1/2" x 14" Portal braces.
Lateral Rod Bolts	4	1 1/4"	21"	Change number to 8.

81 FT HOWE TRUSS BRIDGE
OVER ROSEAU RIVER
N35-1-6E
MUN. OF STUARTBURN

Dept. of Public Works
Highway Commissioners office
March 1918. Manitoba

Designed by N.B. Macdougall Traced by G.G.T.
Checked by [illegible] Revised by ....
Approved by [illegible] Highway Commissioner

SCALE 1/4 IN = 1 FT | SHEET No 1/2 | PLAN No 381.

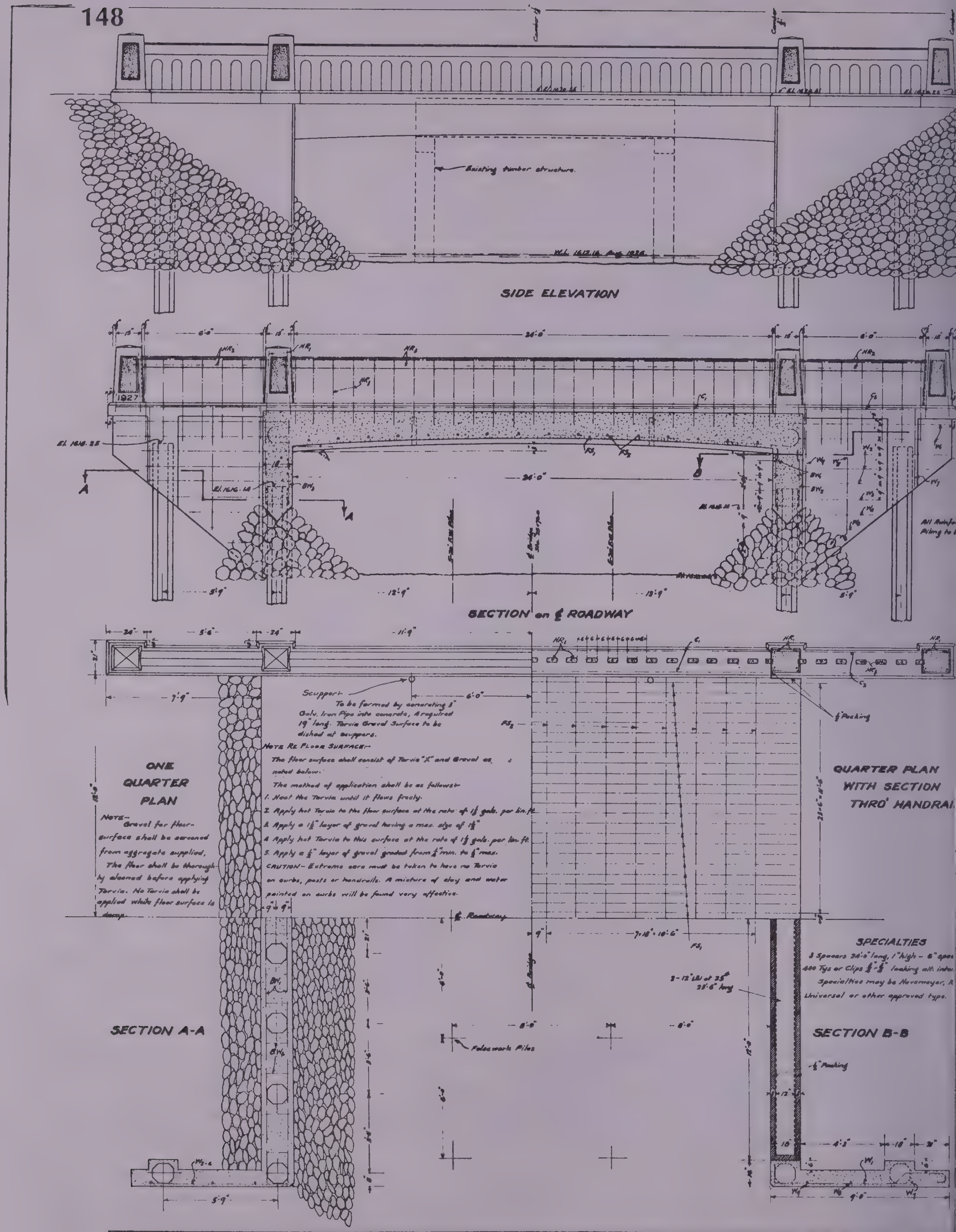
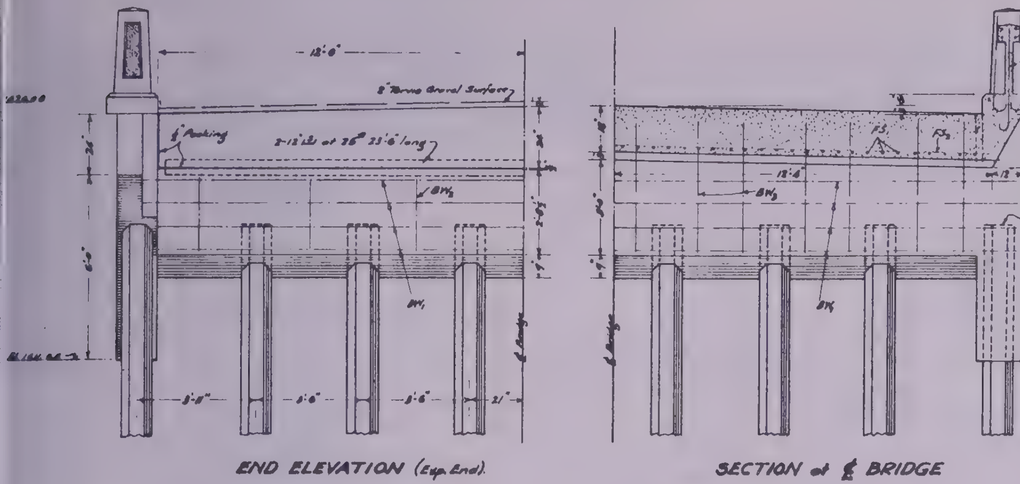

SIDE ELEVATION
Existing timber structure.
1927
SECTION on ℄ ROADWAY
ONE QUARTER PLAN
NOTE–
Gravel for floor-surface shall be screened from aggregate supplied,
The floor shall be thoroughly cleaned before applying Tarvia. No Tarvia shall be applied while floor surface is damp.
Scupper–
To be formed by concreting 3" Galv. Iron Pipe into concrete, 4 required 19" long. Tarvia Gravel Surface to be dished at scuppers.
NOTE RE FLOOR SURFACE:–
The floor surface shall consist of Tarvia "X" and Gravel as noted below.
The method of application shall be as follows:–
1. Heat the Tarvia until it flows freely.
2. Apply hot Tarvia to the floor surface at the rate of 1⅓ gals. per lin. ft.
3. Apply a 1½" layer of gravel having a max. size of 1½"
4. Apply hot Tarvia to this surface at the rate of 1⅓ gals. per lin. ft.
5. Apply a ½" layer of gravel graded from ¼" min. to ½" max.
CAUTION– Extreme care must be taken to have no Tarvia on curbs, posts or handrails. A mixture of clay and water painted on curbs will be found very effective.
QUARTER PLAN WITH SECTION THRO' HANDRAIL
℄ Roadway
Falsework Piles
SECTION A-A
SPECIALTIES
3 Spacers 24'-0" long, 1" high – 6" spac
400 Tys or Clips ⅜"-⅜" locking alt. inter.
Specialties may be Havemeyer, R
Universal or other approved type.
SECTION B-B

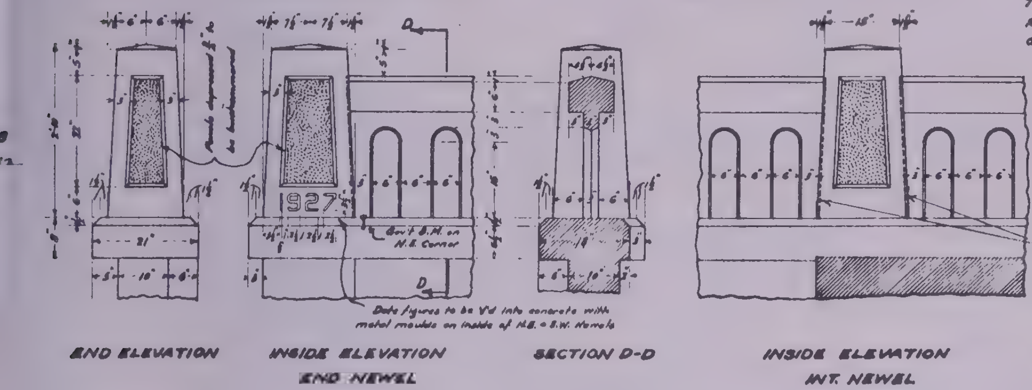
PLATE No. 16(a)



Note- Packing may consist of Phillip Carey Co's "Elastite", The Hoosier Asphalt Co's "Hoosier Expansion Joint"; or any asphaltic compound approved by the Bridge Engineer.

APPROXIMATE
BILL OF QUANTITIES

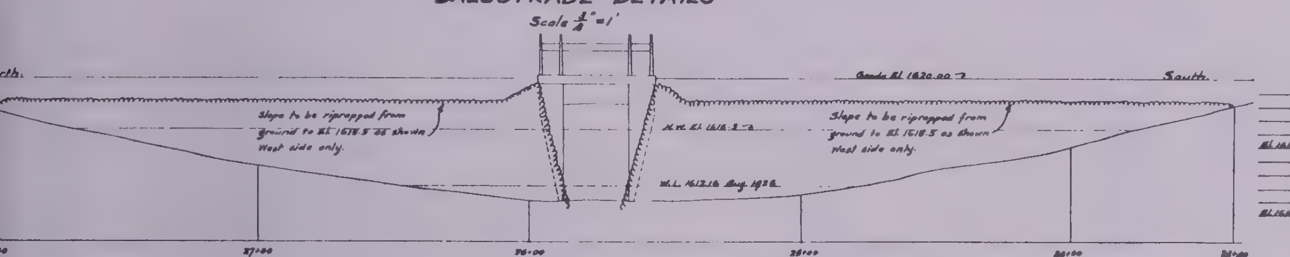
Excavation	60 cu.yds
Concrete	61.5 " "
Cement	118 bbls.
Reinf. Steel	6720 lbs.
Struct. "	1175 "
R.C. Piling	440 lin.ft.
F.W. Piling	200 " "
Packing ½" thick	30 sq.ft.
Gas Pipe Sleeves ⅝" I.D. 6" lg.	48 only
3" Galv. Iron Pipe, 19" lg.	4 "
Tarvia "X"	3 bbls.
Rip Rap	800 cu.yds
Gravel for Floor Surface. 1½"	3 " "
½" to ⅝"	1 " "



Packing ⅝" thick of this shape to be placed at junction of all handrails with newel posts. Packing to be entirely concealed within newel posts. 12 pieces required. Gas Pipe Sleeves ⅝" I.D. 6" long shall be placed in the newels to receive ends of HR_2 and HR_3 bars. 48 Sleeves required.

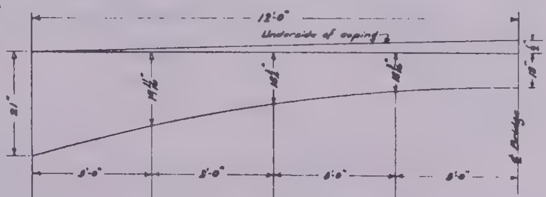
BALUSTRADE DETAILS

Scale ½" = 1'



GENERAL ELEVATION

Scales 30' = 1" Hor.
6' = 1" Ver.



CURVE for UNDERSIDE of SLAB

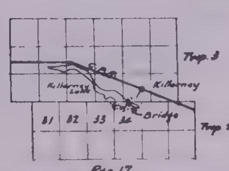
Not to scale.

BILL OF REINFORCING STEEL

All reinforcing steel to be "Intermediate grade".

Mark	No	Size	Length	Location	Sketch	Weight
HR_1	110	½"□	3'-6"	Newel Posts and Handrail Vert.	3'-0"	257
HR_2	16	"	7'-0"	Handrail Long'l over wings.	Straight Bars	95
HR_3	8	"	25'-6"	" " " span.		134
C_1	4	"	16'-5"	Curb Long'l " "		92
C_2	4	"	10'-5"	" " " wings.	x for C_1 = 13'-6" x for C_2 = 8'-6"	27
BW_1	16	"	26'-0"	Breastwall Hor.	Straight Bar	278
BW_2	7	"	5'-9"	" Vert. Exp. End.		27
BW_3	14	"	9'-5"	" " Fix. "	x for BW_2 = 3'-4" x for BW_3 = 4'-1"	87
FS_1	48	1"□	29'-0"	Floor Slab Long'l.	26'-6"	4733
FS_2	16	¾"□	26'-6"	" " Trans.	24'-6"	685
W_1	8	⅝"□	10'-5"	Wingwall Hor.	6'-0" 6" 23"	87
W_2	12	"	8'-0"	" "		100
W_3	4	"	7'-0"	" "	x for W_2 = 7'-0" x for W_3 = 6'-0"	29
W_4	4	"	6'-0"	" "	W_4 = 5'-0" W_5 = 4'-0"	25
W_5	4	"	5'-0"	" "	W_6 = 3'-0"	21
W_6	4	"	4'-0"	" "		17
W_7	4	½"□	3'-9"	" Vert.		10
W_8	4	"	6'-0"	" "	Straight Bars.	16
W_9	4	"	7'-6"	" "		20
					Total	6720

Structural Steel – 2-12" Ib at 25# – 30'-6" long. Total weight = 1175#
Heavily galvanized by "Hot Dip Process".



LOCATION PLAN

BALUSTRADE FORMS
1 Pair required for each opening.

LOADING – 15 ton truck plus 30% Impact.
UNIT STRESSES – f_c = 800#/", f_s = 18000#/"

24 FT. REINF. CONCRETE BRIDGE
IN 34-2-17 W
TURTLE MOUNTAIN MUN.

DEPARTMENT OF PUBLIC WORKS
GOOD ROADS BOARD
MANITOBA

Designed by B.A.J. Drawn by B.A.J. Traced by B.A.J.
Engineer in Charge B.A. Johnston Checked by G.P.W.
Approved by M.A. Lyons Chief Engineer
Date April 1927
SCALE ½" = 1' SHEET NO. 4 PLAN NO. 1337

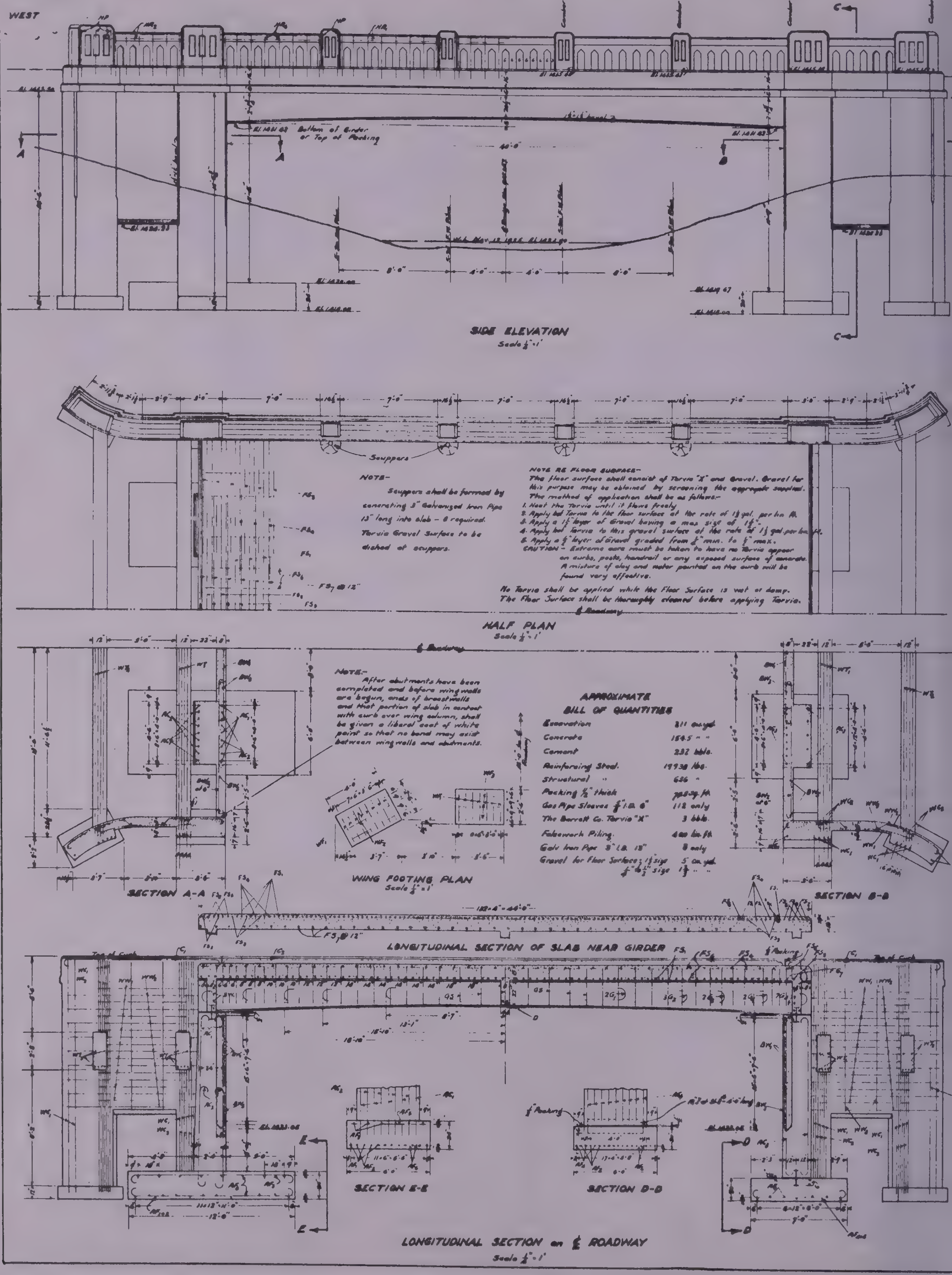
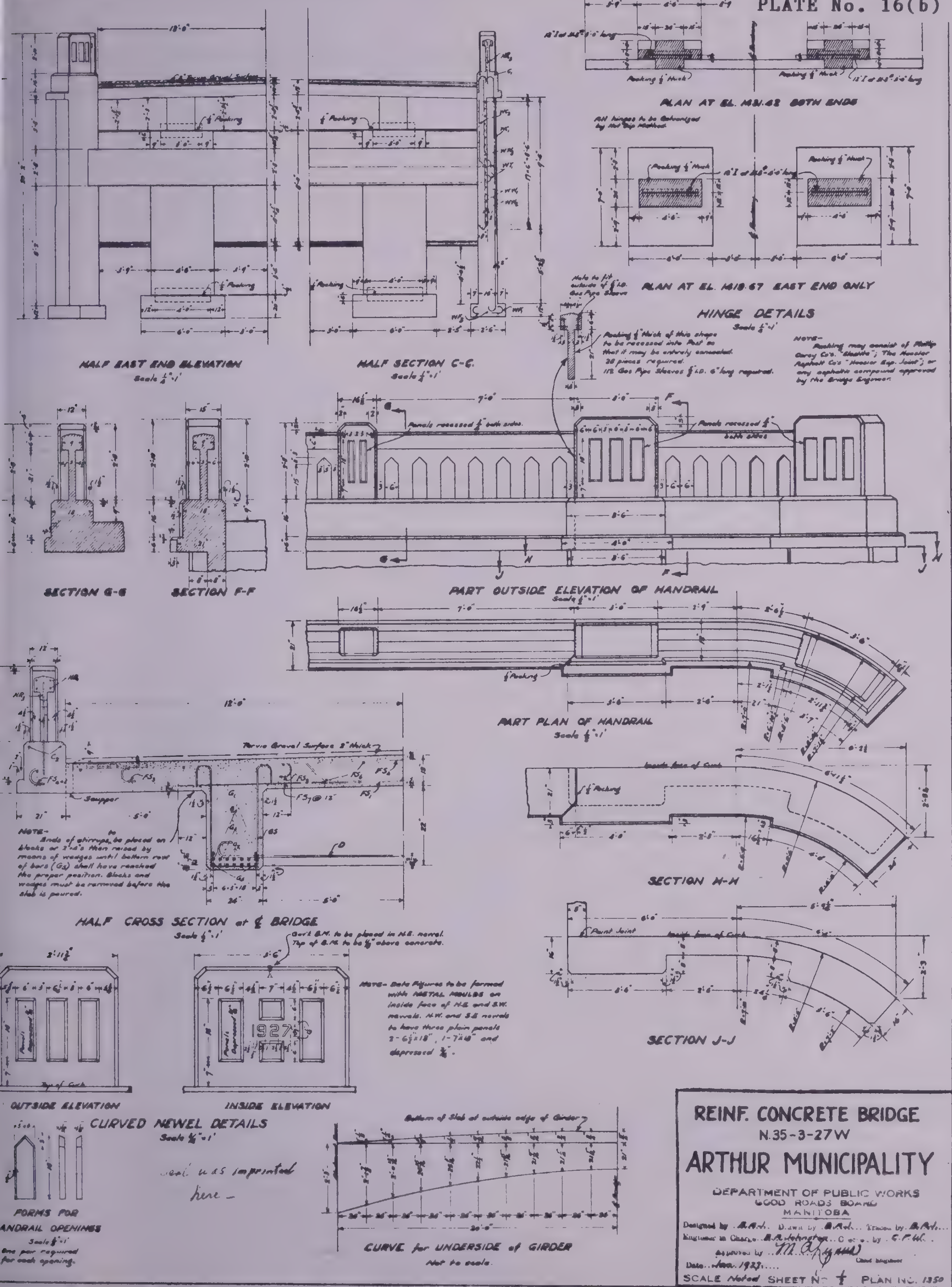
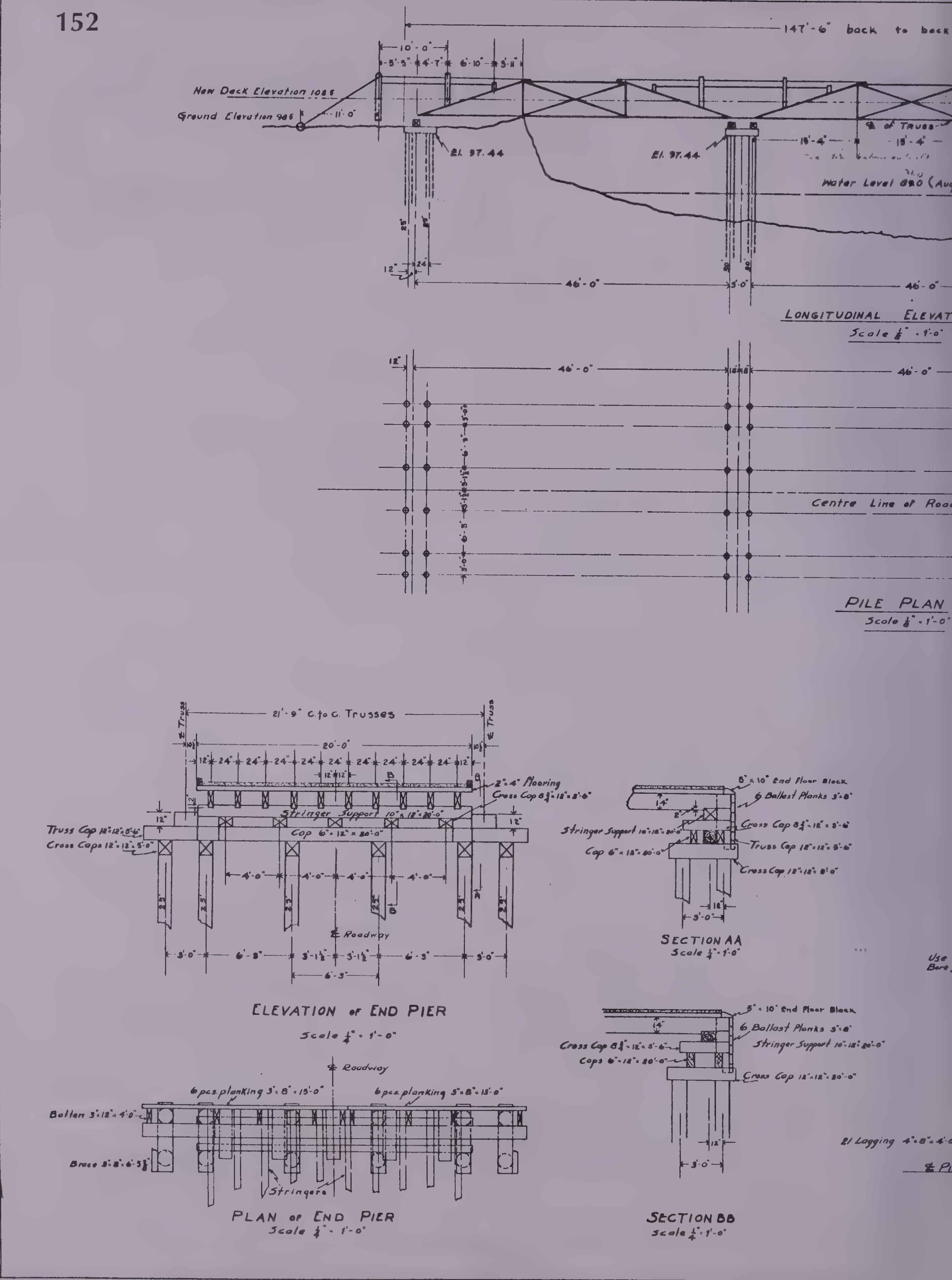

WEST
SIDE ELEVATION
Scale 1/4" = 1'
Bottom of Girder or Top of Packing
Scuppers
NOTE–
Scuppers shall be formed by concreting 3" Galvanized Iron Pipe 13" long into slab – 8 required. Tarvia Gravel Surface to be dished at scuppers.
NOTE RE FLOOR SURFACE–
The floor surface shall consist of Tarvia "X" and Gravel. Gravel for this purpose may be obtained by screening the aggregate supplied. The method of application shall be as follows:–
1. Heat the Tarvia until it flows freely
2. Apply hot Tarvia to the floor surface at the rate of 1/3 gal. per lin. ft.
3. Apply a 1/2" layer of Gravel having a max size of 1/2".
4. Apply hot Tarvia to this gravel surface at the rate of 1/3 gal. per lin. ft.
5. Apply a 1/4" layer of Gravel graded from 1/8" min. to 1/4" max.
CAUTION – Extreme care must be taken to have no Tarvia appear on curbs, posts, handrail or any exposed surface of concrete. A mixture of clay and water painted on the curb will be found very effective.
No Tarvia shall be applied while the Floor Surface is wet or damp.
The Floor Surface shall be thoroughly cleaned before applying Tarvia.
℄ Roadway
HALF PLAN
Scale 1/4" = 1'
NOTE:–
After abutments have been completed and before wing walls are begun, ends of breastwalls and that portion of slab in contact with curb over wing column, shall be given a liberal coat of white paint so that no bond may exist between wing walls and abutments.
APPROXIMATE
BILL OF QUANTITIES
Excavation 311 cu. yd.
Concrete 154.5 " "
Cement 232 bbls.
Reinforcing Steel. 19938 lbs.
Structural " 636 "
Packing 1/2" thick 728 sq. ft.
Gas Pipe Sleeves 3/4" I.D. 6" 112 only
The Barrett Co. Tarvia "X" 3 bbls.
Falsework Piling. 400 lin. ft.
Galv. Iron Pipe 3" I.D. 13" 8 only
Gravel for Floor Surface; 1/2" size 5 cu. yd.
1/8" to 1/4" size 1 1/2 " "
SECTION A-A
WING FOOTING PLAN
Scale 1/4" = 1'
SECTION B-B
LONGITUDINAL SECTION OF SLAB NEAR GIRDER
Top of Curb
SECTION E-E
SECTION D-D
LONGITUDINAL SECTION on ℄ ROADWAY
Scale 1/4" = 1'

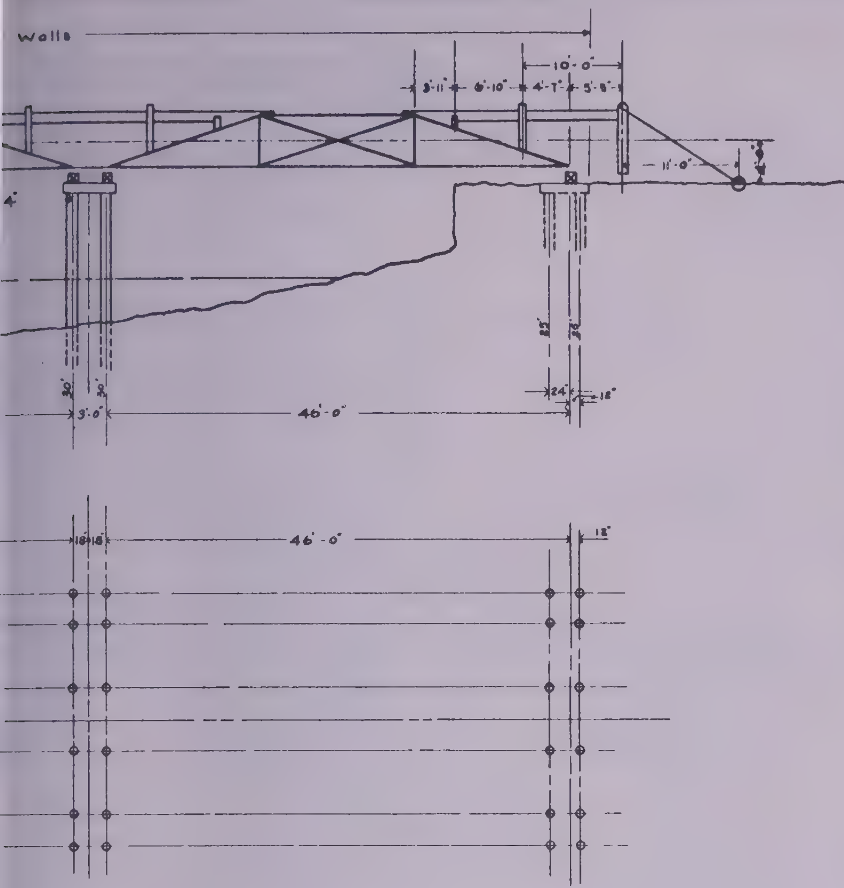
PLATE No. 16(b)

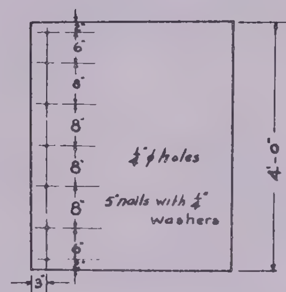

PLAN AT EL. 1431.62 BOTH ENDS
All hinges to be Galvanized by Hot Dip Method.
PLAN AT EL. 1418.67 EAST END ONLY
HINGE DETAILS
Scale 1/2"=1'
HALF EAST END ELEVATION
Scale 1/4"=1'
HALF SECTION C-C.
Scale 1/4"=1'
NOTE-
Packing may consist of Phillip Carey Co's. "Elastite"; The Mexican Asphalt Co's "Mexolar Exp. Joint"; or any asphaltic compound approved by the Bridge Engineer.
Panels recessed 1/2" both sides.
SECTION G-G
SECTION F-F
PART OUTSIDE ELEVATION OF HANDRAIL
Scale 1/2"=1'
PART PLAN OF HANDRAIL
Scale 1/2"=1'
SECTION H-H
SECTION J-J
Tarvia Gravel Surface 3" thick
Scupper
NOTE-
Ends of stirrups to be placed on blocks or 2x4's then raised by means of wedges until bottom row of bars (G2) shall have reached the proper position. Blocks and wedges must be removed before the slab is poured.
HALF CROSS SECTION at ℄ BRIDGE
Scale 1/2"=1'
Gov't B.M. to be placed in N.E. newel. Top of B.M. to be 1/8" above concrete.
NOTE- Date Figures to be formed with METAL MOULDS on inside face of N.E. and S.W. newels. N.W. and S.E. newels to have three plain panels 2-6 1/2x18", 1-7x18" and depressed 3/8".
1927
OUTSIDE ELEVATION
INSIDE ELEVATION
CURVED NEWEL DETAILS
Scale 1/2"=1'
seal was imprinted here –
FORMS FOR HANDRAIL OPENINGS
Scale 1/2"=1'
One pair required for each opening.
Bottom of Slab at outside edge of Girder
CURVE for UNDERSIDE of GIRDER
Not to scale.
REINF. CONCRETE BRIDGE
N.35-3-27W
ARTHUR MUNICIPALITY
DEPARTMENT OF PUBLIC WORKS
GOOD ROADS BOARD
MANITOBA
Designed by B.A.J. Drawn by B.A.J. Traced by B.A.J.
Engineer in Charge B.A. Johnston Checked by G.F.W.
Approved by M.A. Lyons Chief Engineer
Date Nov. 1927
SCALE Noted SHEET No. 4 PLAN No. 1350



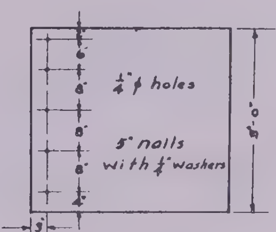
147'-6" back to back
New Deck Elevation 102.5
Ground Elevation 98.5
El. 97.44
El. 97.44
Water Level 89.0 (Au
46'-0"
46'-0"
LONGITUDINAL ELEVAT
Scale 1/8" = 1'-0"
Centre Line of Roa
PILE PLAN
Scale 1/8" = 1'-0"
21'-9" C. to C. Trusses
20'-0"
2"x4" Flooring
Cross Cap 8 1/2" x 12" x 8'-6"
Stringer Support 10" x 12" x 20'-0"
Cap 6" x 12" x 20'-0"
Truss Cap 12" x 12" x 5'-6"
Cross Caps 12" x 12" x 5'-0"
Roadway
ELEVATION OF END PIER
Scale 1/4" = 1'-0"
6 pcs planking 3" x 8" x 15'-0"
Ballen 3" x 12" x 4'-0"
Brace 3" x 8" x 6'-5 1/2"
Stringers
PLAN OF END PIER
Scale 1/4" = 1'-0"
8" x 10" End Floor Block
6 Ballast Planks 3" x 8"
Cross Cap 8 1/2" x 12" x 8'-6"
Stringer Support 10" x 12" x 20'-0"
Truss Cap 12" x 12" x 5'-6"
Cap 6" x 12" x 20'-0"
Cross Cap 12" x 12" x 8'-0"
SECTION AA
Scale 1/4" = 1'-0"
8" x 10" End Floor Block
6 Ballast Planks 3" x 8"
Stringer Support 10" x 12" x 20'-0"
Cross Cap 8 1/2" x 12" x 5'-6"
Caps 6" x 12" x 20'-0"
Cross Cap 12" x 12" x 20'-0"
SECTION BB
Scale 1/4" = 1'-0"
21 Logging 4" x 8" x 4'-0"

PLATE No. 17(a)



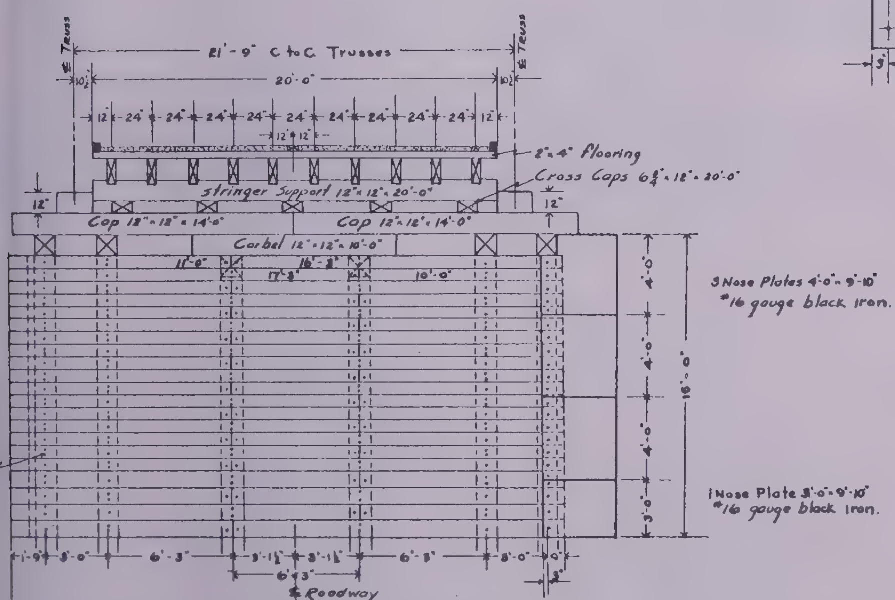


NAIL SPACING FOR 4' SHEET
Scale 3/4" = 1'-0"



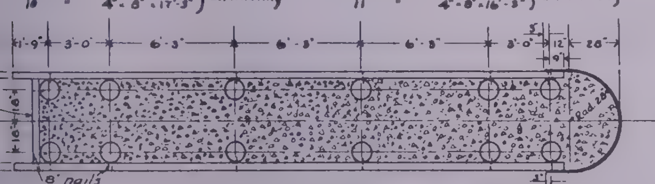
NAIL SPACING FOR 3' SHEET
Scale 3/4" = 1'-0"

NOTE:
Nose plates to be rolled to conform to shape and dimensions shown.



ELEVATION of CENTRE PIER

11 Logging 4" x 8" x 11'-0" / 10 " 4" x 8" x 17'-3" } alternating
10 Logging 4" x 8" x 10'-0" / 11 " 4" x 8" x 16'-3" } alternating



PLAN of CENTRE PIER
Scale 1/4" = 1'-0"

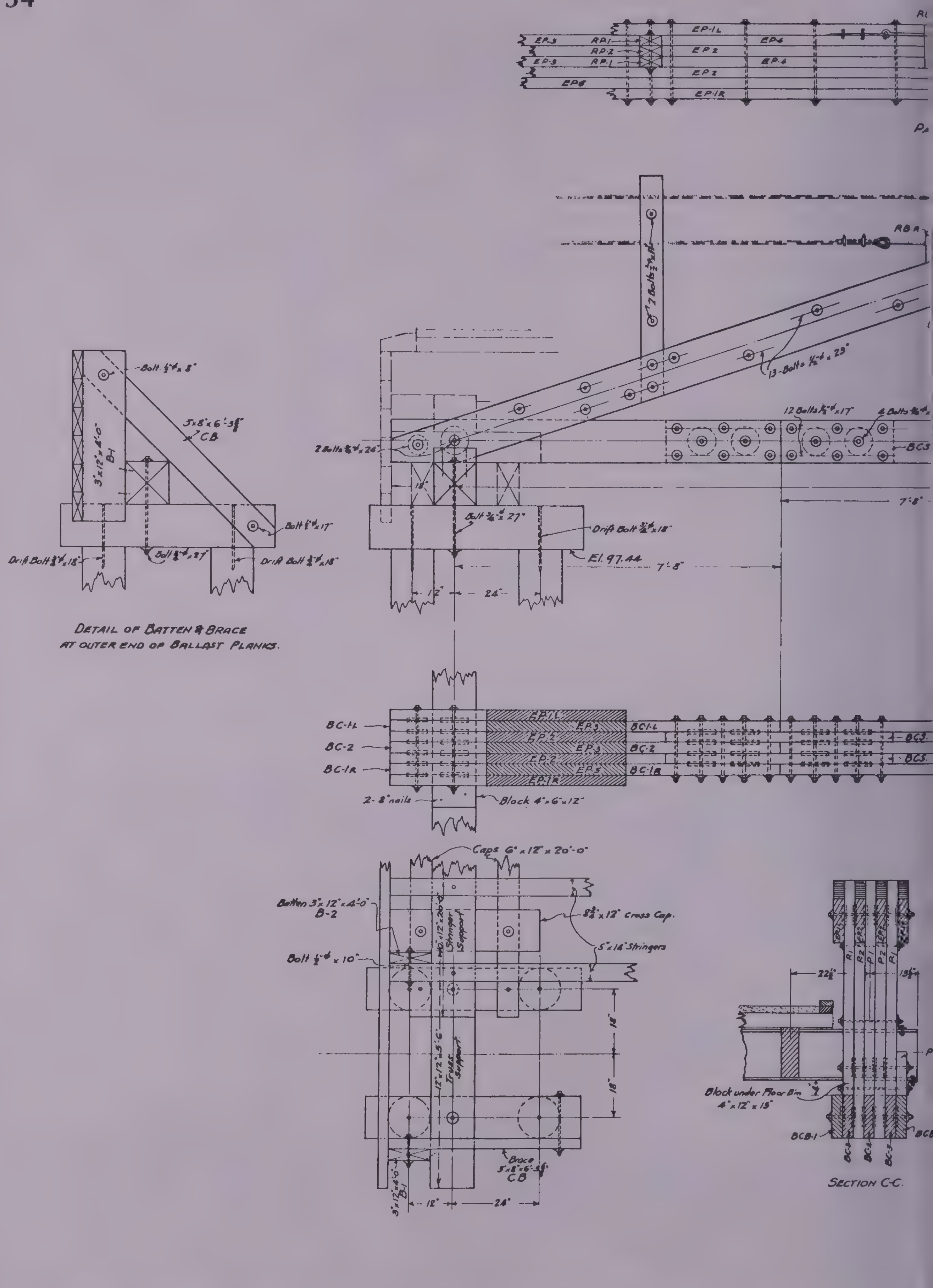
PILES 20'-0" long

TREATED TIMBER BRIDGE
OVER FISHER RIVER
N.E. 14-28-1W.
UNORGANIZED TER.

Dec. 1944
as shown

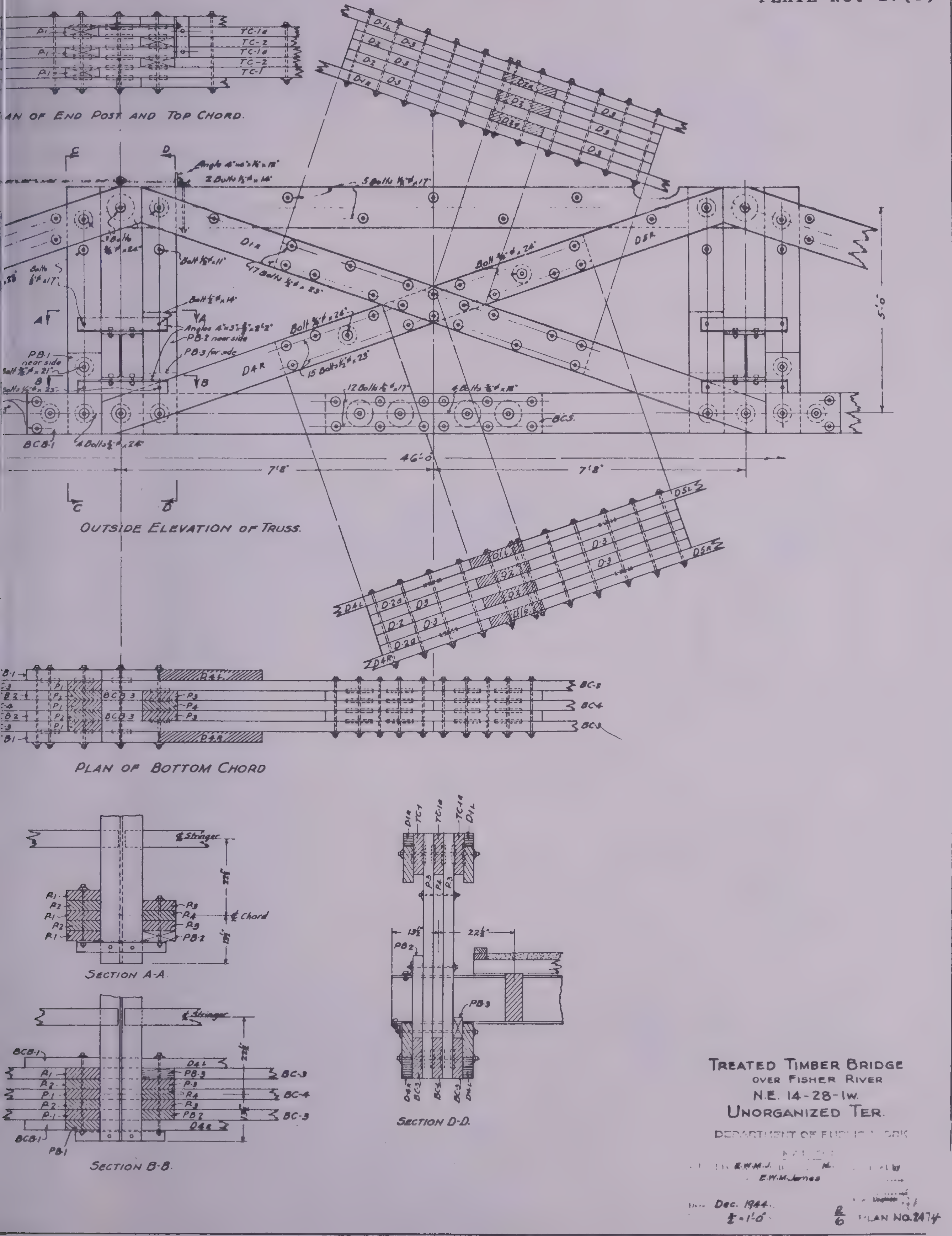
1/6

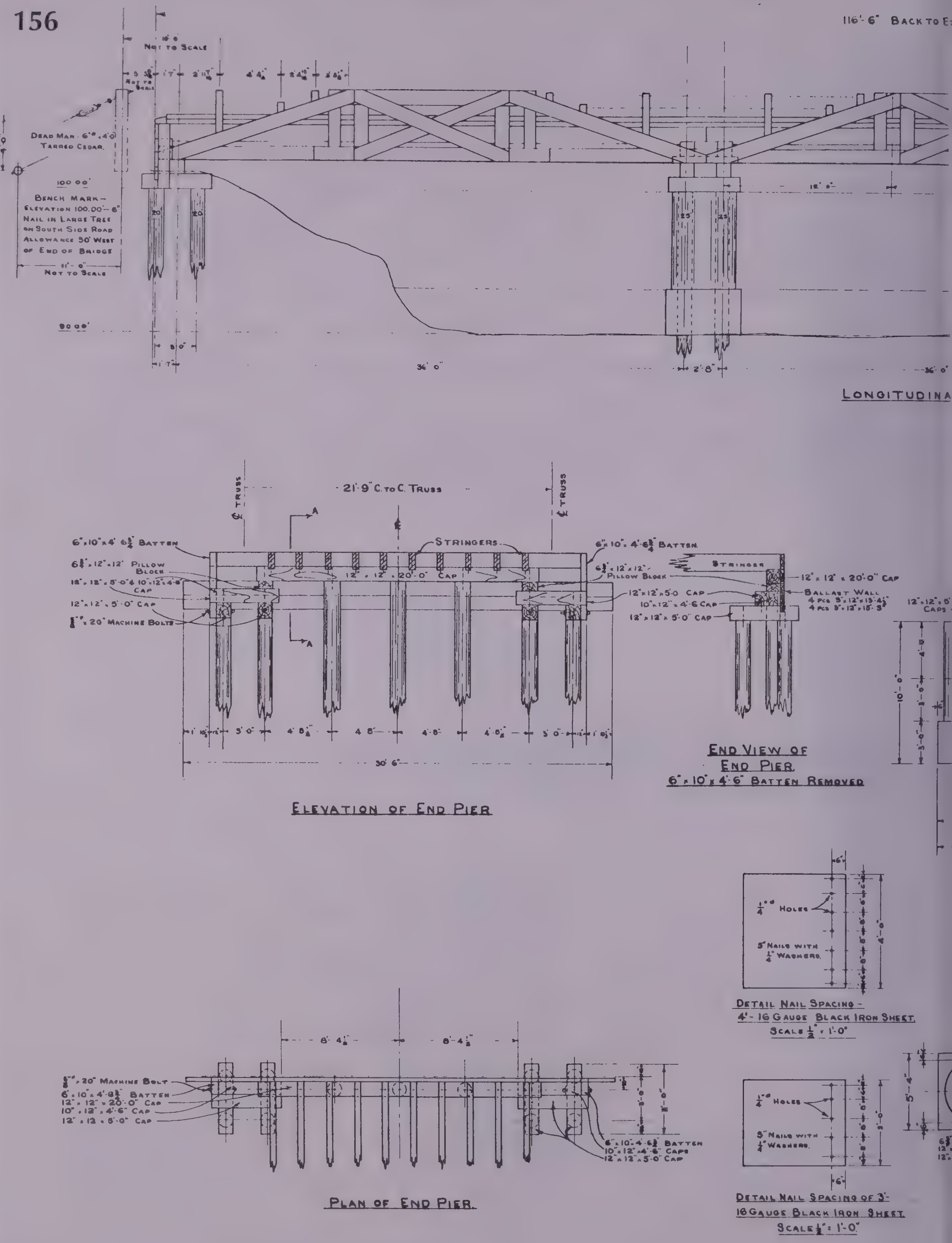
2474

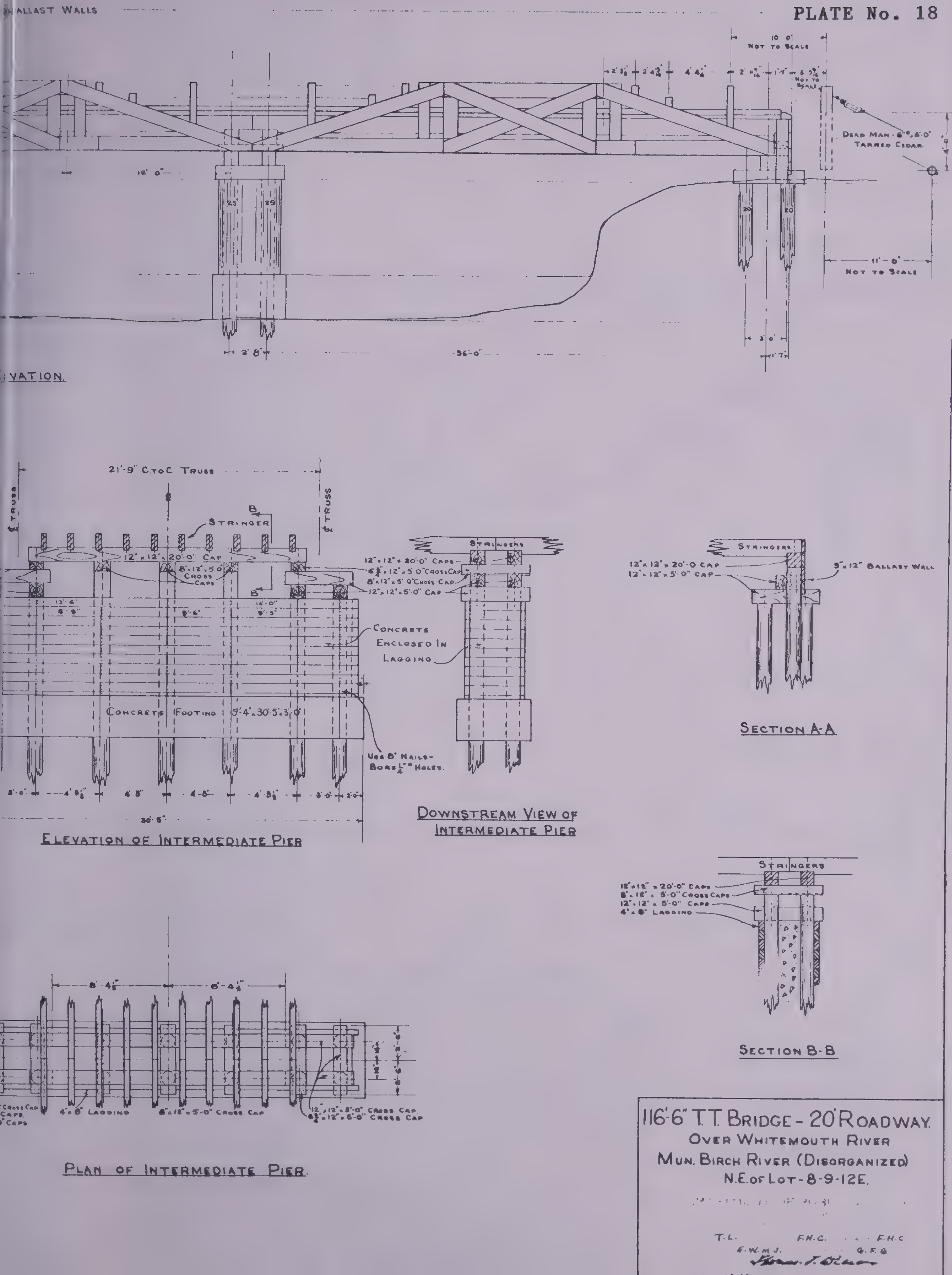


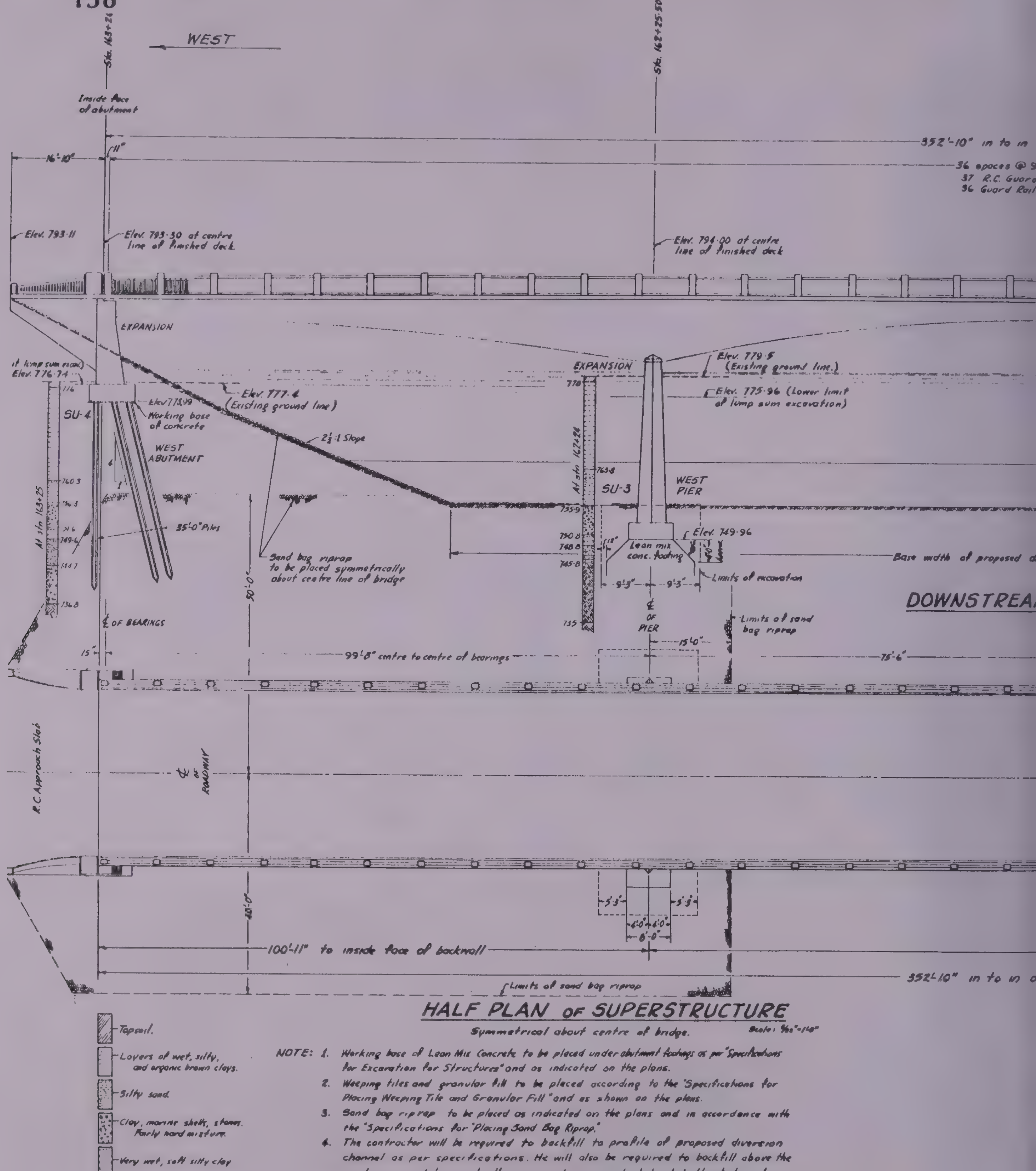
EP-1L
EP-3
RP-1
RP-2
EP-2
EP-4
EP-6
EP-1R
RB-R
2 Bolts ½"ϕ x 15"
13-Bolts ¾"ϕ x 23"
12 Bolts ¾"ϕ x 17"
2 Bolts ¾"ϕ x 24"
BC3
7'-8"
Bolt ¾"ϕ x 27"
Drift Bolt ¾"ϕ x 18"
El. 97.44
12"
24"
Bolt ½"ϕ x 8"
5"x 8"x 6'-3⅝"
CB
3"x 12"x 4'-0"
B-1
Bolt ½"ϕ x 17"
Bolt ¾"ϕ x 27"
Drift Bolt ¾"ϕ x 18"
DETAIL OF BATTEN & BRACE
AT OUTER END OF BALLAST PLANKS.
BC-1L
BC-2
BC-1R
EP-3
EP-5
2-8" nails
Block 4"x 6"x 12"
Caps 6"x 12"x 20'-0"
Batten 3"x 12"x 4'-0"
B-2
8¾"x 12" Cross Cap.
5"x 14" Stringers
Bolt ½"ϕ x 10"
Stringer Support
Truss Support
18"
Brace
5"x 8"x 6'-3⅝"
CB
3"x 12"x 4'-0"
B-1
22⅝"
13⅝"
Block under Floor Bin
4"x 12"x 15"
BCB-1
SECTION C-C.

PLATE No. 17(b)


PLAN OF END POST AND TOP CHORD.
OUTSIDE ELEVATION OF TRUSS.
46'-0"
7'-8"
7'-8"
5'-0"
PLAN OF BOTTOM CHORD
SECTION A-A.
SECTION B-B.
SECTION D-D.
TREATED TIMBER BRIDGE
OVER FISHER RIVER
N.E. 14-28-1W.
UNORGANIZED TER.
E.W.M. James
Dec. 1944.
PLAN NO. 2474


116'-6" BACK TO E
NOT TO SCALE
DEAD MAN 6"⌀ x 4'0" TARRED CEDAR.
100.00'
BENCH MARK – ELEVATION 100.00 – 6" NAIL IN LARGE TREE ON SOUTH SIDE ROAD ALLOWANCE 50' WEST OF END OF BRIDGE
NOT TO SCALE
90.00'
36' 0"
2' 8"
LONGITUDINA
21'-9" C. TO C. TRUSS
℄ TRUSS
STRINGERS
6" x 10" x 4' 6½" BATTEN
6½" x 12" x 12" PILLOW BLOCK
12" x 12" x 20'-0" CAP
12" x 12" x 5'-0" CAP
⅝" x 20" MACHINE BOLTS
30' 6"
ELEVATION OF END PIER
STRINGER
BALLAST WALL
10" x 12" x 4'-6" CAP
END VIEW OF END PIER
6" x 10" x 4'-6" BATTEN REMOVED
¼"⌀ HOLES
5" NAILS WITH ¼" WASHERS.
DETAIL NAIL SPACING – 4' - 16 GAUGE BLACK IRON SHEET.
SCALE ½" = 1'-0"
⅝"⌀ x 20" MACHINE BOLT
6" x 10" x 4'-6½" BATTEN
12" x 12" x 20'-0" CAP
10" x 12" x 4'-6" CAP
12" x 12" x 5'-0" CAP
8'-4½"
PLAN OF END PIER.
DETAIL NAIL SPACING OF 3' - 16 GAUGE BLACK IRON SHEET
SCALE ½" = 1'-0"


BALLAST WALLS
10' 0" NOT TO SCALE
DEAD MAN - 6"ø, 4'-0" TARRED CEDAR
11'-0" NOT TO SCALE
12' 0"
2' 8"
36'-0"
ELEVATION.
21'-9" C. TO C. TRUSS
STRINGER
12" x 12" x 20'-0" CAP
8" x 12" x 5'-0" CROSS CAPS
CONCRETE ENCLOSED IN LAGGING
CONCRETE FOOTING 5'-4" x 30'-5" x 3'-0"
USE 8" NAILS - BORE 1/4" HOLES.
30'-5"
ELEVATION OF INTERMEDIATE PIER
STRINGERS
12" x 12" x 20'-0" CAPS
6 1/2" x 12" x 5'-0" CROSS CAP
8" x 12" x 5'-0" CROSS CAP
12" x 12" x 5'-0" CAP
DOWNSTREAM VIEW OF INTERMEDIATE PIER
12" x 12" x 20'-0" CAP
12" x 12" x 5'-0" CAP
5" x 12" BALLAST WALL
SECTION A-A
4" x 8" LAGGING
SECTION B-B
8'-4 1/2"
4" x 8" LAGGING
8" x 12" x 5'-0" CROSS CAP
12" x 12" x 5'-0" CROSS CAP
6 1/2" x 12" x 5'-0" CROSS CAP
PLAN OF INTERMEDIATE PIER.
116'-6" T.T. BRIDGE - 20' ROADWAY.
OVER WHITEMOUTH RIVER
MUN. BIRCH RIVER (DISORGANIZED)
N.E. OF LOT - 8-9-12E.
T.L.
F.H.C.
F.H.C.
E.W.M.J.
G.F.G.



HALF PLAN OF SUPERSTRUCTURE

Symmetrical about centre of bridge. Scale: 3/32"=1'-0"

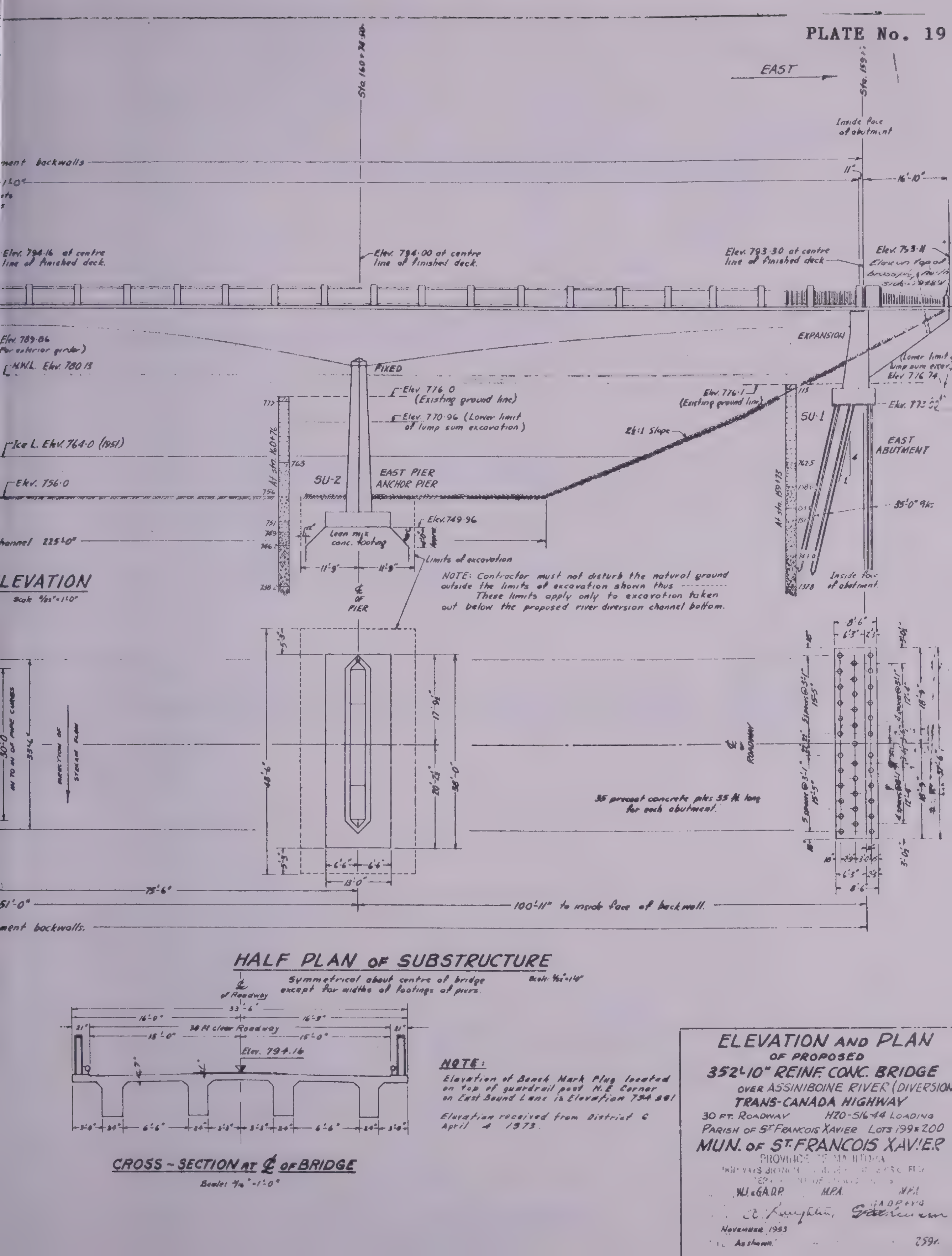
NOTE:

1. Working base of Lean Mix Concrete to be placed under abutment footings as per "Specifications for Excavation for Structures" and as indicated on the plans.
2. Weeping tiles and granular fill to be placed according to the "Specifications for Placing Weeping Tile and Granular Fill" and as shown on the plans.
3. Sand bag riprap to be placed as indicated on the plans and in accordance with the "Specifications for Placing Sand Bag Riprap."
4. The contractor will be required to backfill to profile of proposed diversion channel as per specifications. He will also be required to backfill above the existing ground line up to the proposed new grade behind both abutments in order that he may place granular fill and reinforced concrete approach slabs without the aid of the grading contractor. This fill shall be placed in accordance with the "Special Provisions" and "Specifications for Excavation for Structures." Excess material from pier excavation which is suitable for grade shall be used for this purpose as directed by the Engineer.
5. The contractor is advised that the area within the limits of the right-of-way i.e. 200 ft. will not be disturbed by the grading contractor until after the completion of the superstructure.
6. The log boring data on this sheet is supplied for general information only and the contractor is advised that the Department will not be held responsible for any errors or inaccuracies.

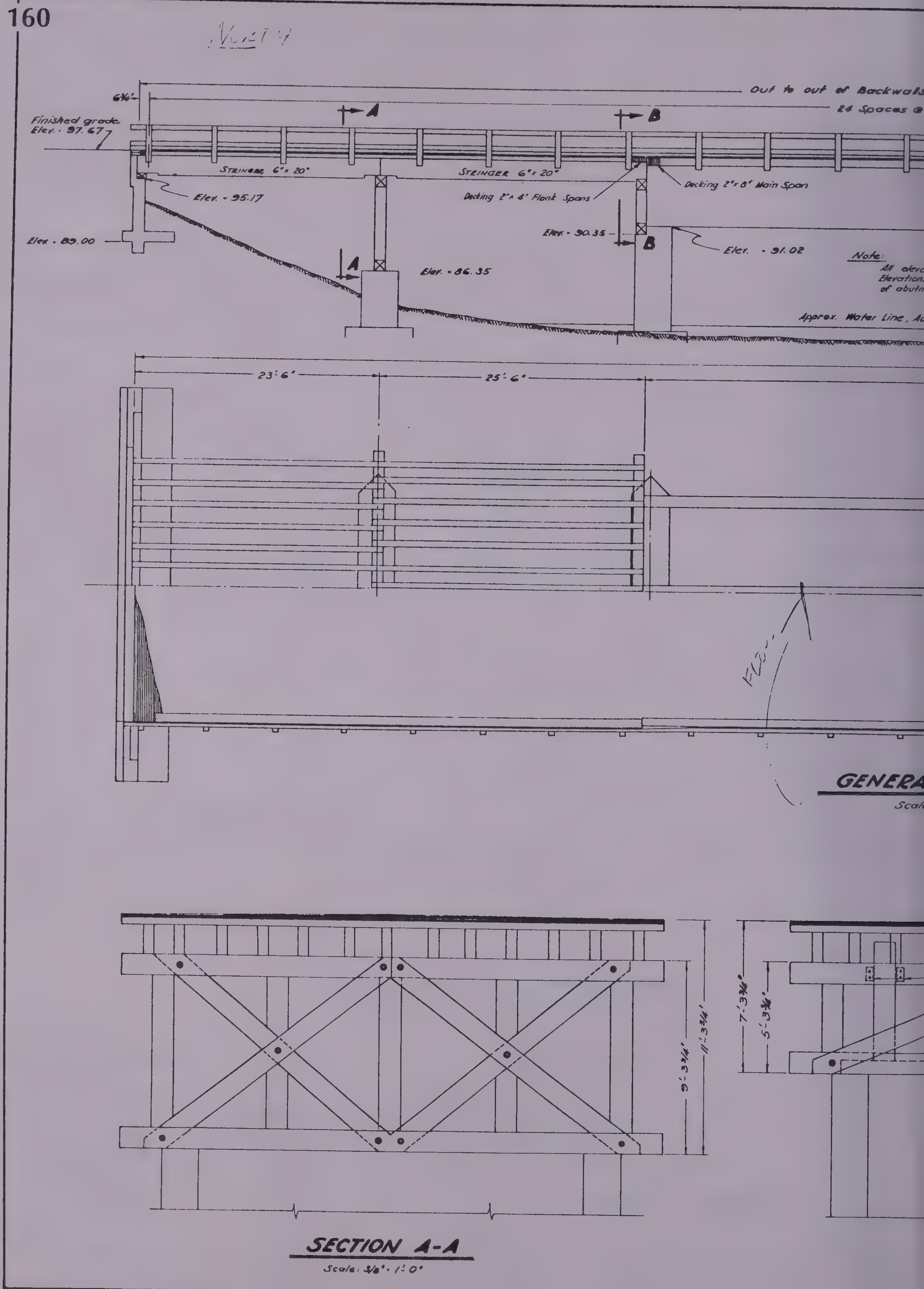
- Topsoil.
- Layers of wet, silty, and organic brown clays.
- Silty sand.
- Clay, marine shells, stones. Fairly hard mixture.
- Very wet, soft silty clay.
- Mixture of medium hard clay, marine shells, sand and small stones.
- Porus layer of limestone, granite boulders, and fractured bedrock.
- Limestone bedrock.

TEST BORING LEGEND

PLATE No. 19



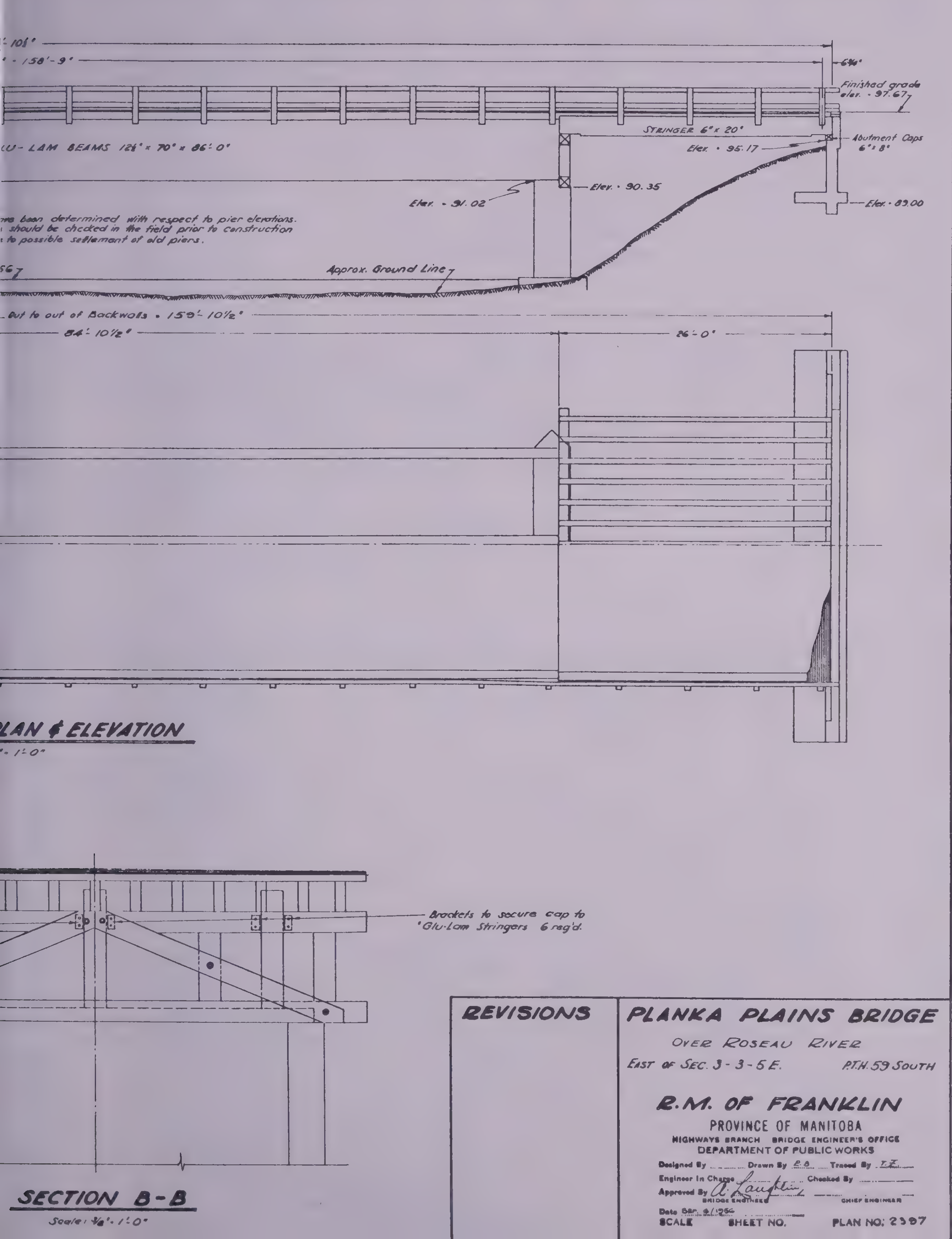
EAST
Sta. 160+74.50
Inside face of abutment
ment backwalls
Elev. 794.16 at centre line of finished deck.
Elev. 794.00 at centre line of finished deck.
Elev. 793.30 at centre line of finished deck
Elev. 789.86 (for exterior girder)
H.W.L. Elev. 780.13
FIXED
EXPANSION
Elev. 776.0 (Existing ground line)
Elev. 770.96 (Lower limit of lump sum excavation)
Elev. 776.1 (Existing ground line)
2½:1 Slope
Ice L. Elev. 764.0 (1951)
Elev. 756.0
SU-2
EAST PIER ANCHOR PIER
SU-1
EAST ABUTMENT
35'-0" Piles
Lean mix conc. footing
Elev. 749.96
Limits of excavation
channel 225'-0"
ELEVATION
NOTE: Contractor must not disturb the natural ground outside the limits of excavation shown thus --------- These limits apply only to excavation taken out below the proposed river diversion channel bottom.
℄ OF PIER
℄ ROADWAY
35 precast concrete piles 35 ft. long for each abutment.
75'-6"
51'-0"
100'-11" to inside face of backwall.
ment backwalls.
HALF PLAN OF SUBSTRUCTURE
Symmetrical about centre of bridge except for widths of footings of piers.
℄ of Roadway
33'-6"
16'-9"
30 ft clear Roadway
15'-0"
Elev. 794.16
CROSS-SECTION AT ℄ OF BRIDGE
NOTE:
Elevation of Bench Mark Plug located on top of guardrail post N.E. Corner on East Bound Lane is Elevation 794.81
Elevation received from District 6 April 4 1973.
ELEVATION AND PLAN OF PROPOSED
352'-10" REINF. CONC. BRIDGE
OVER ASSINIBOINE RIVER (DIVERSION)
TRANS-CANADA HIGHWAY
30 FT. ROADWAY
H20-S16-44 LOADING
PARISH OF ST. FRANCOIS XAVIER LOTS 199 & 200
MUN. OF ST. FRANCOIS XAVIER
November 1953



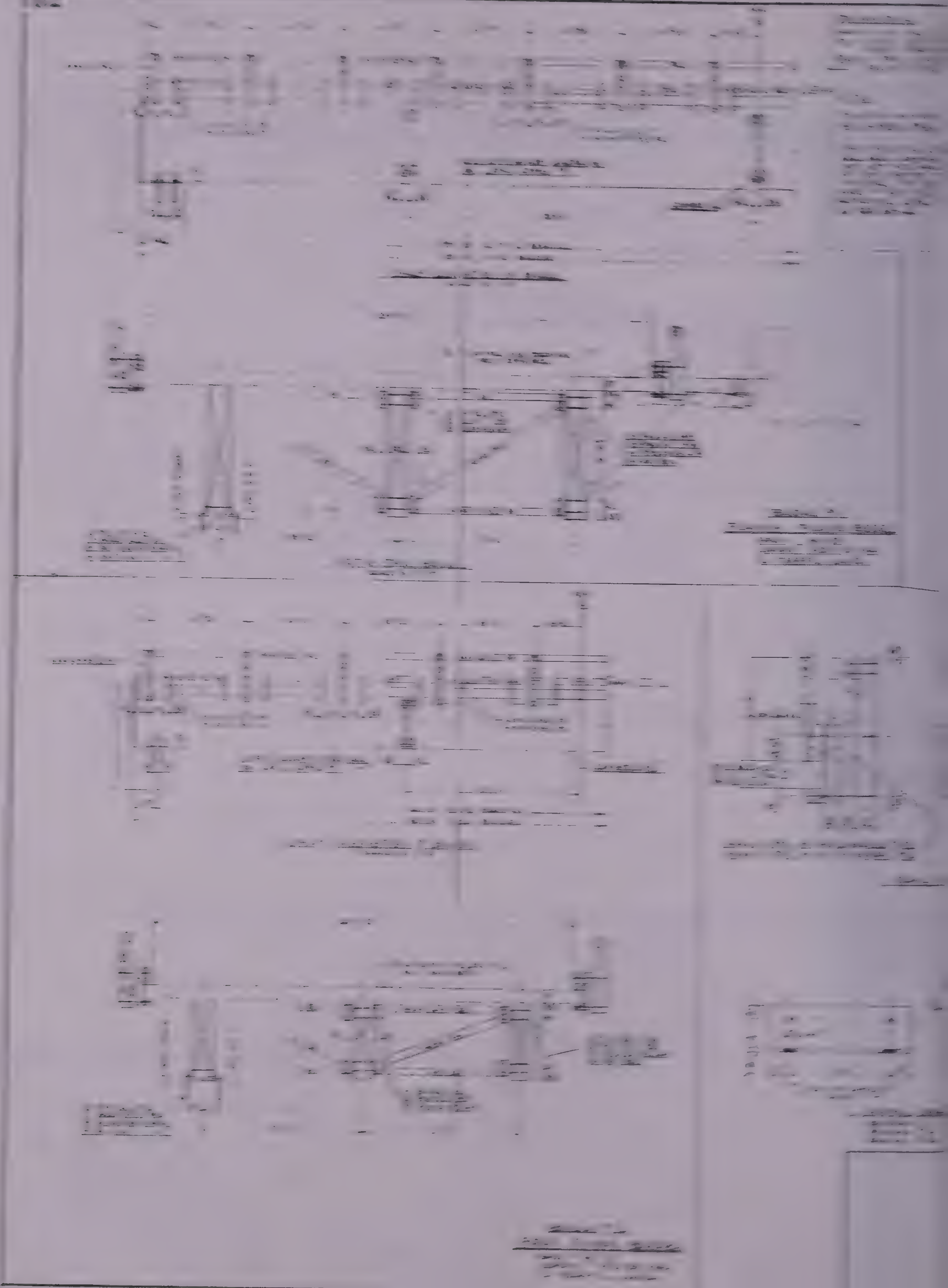
SECTION A-A

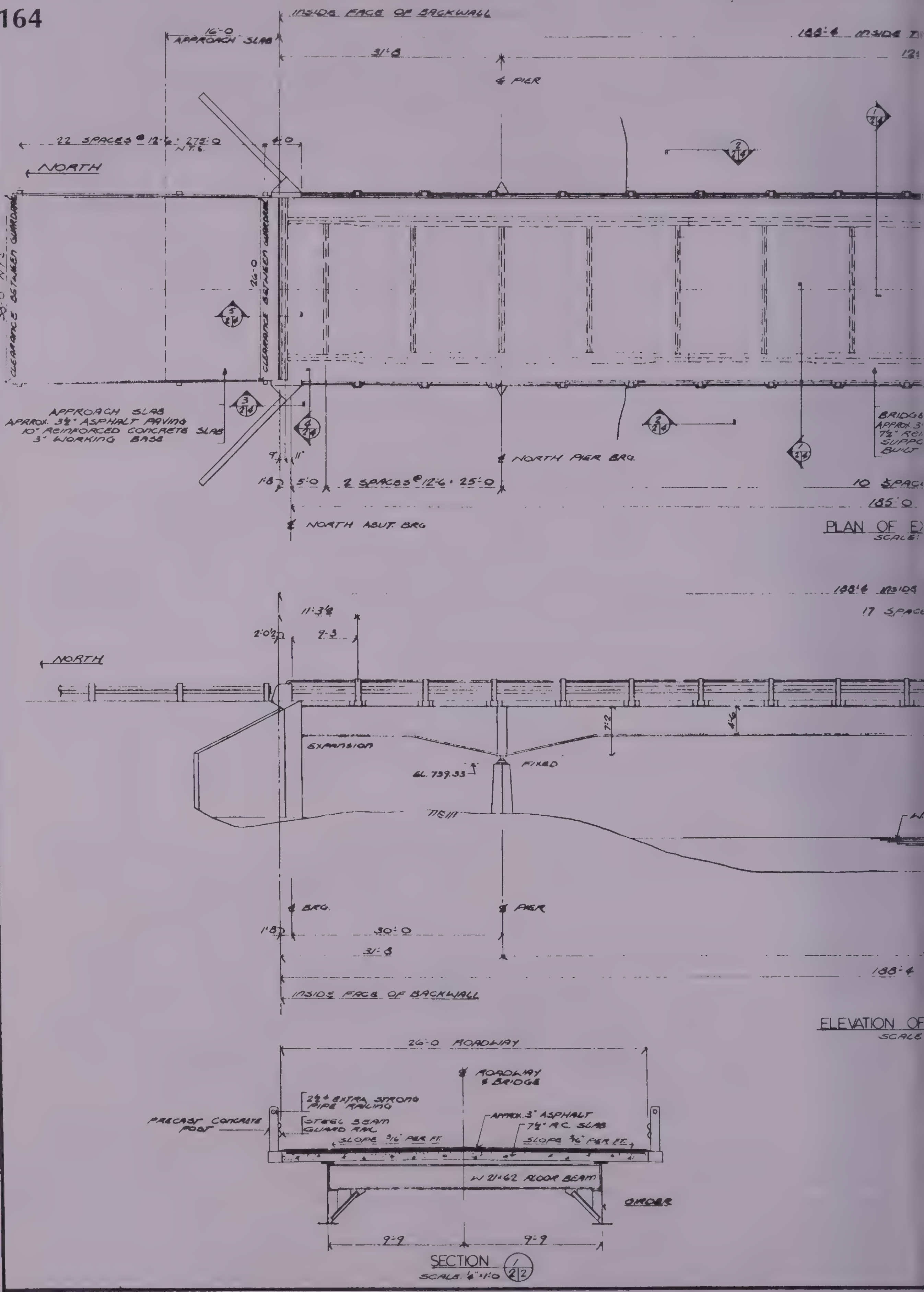
Scale: 3/8" - 1'-0"

PLATE No. 20(a)

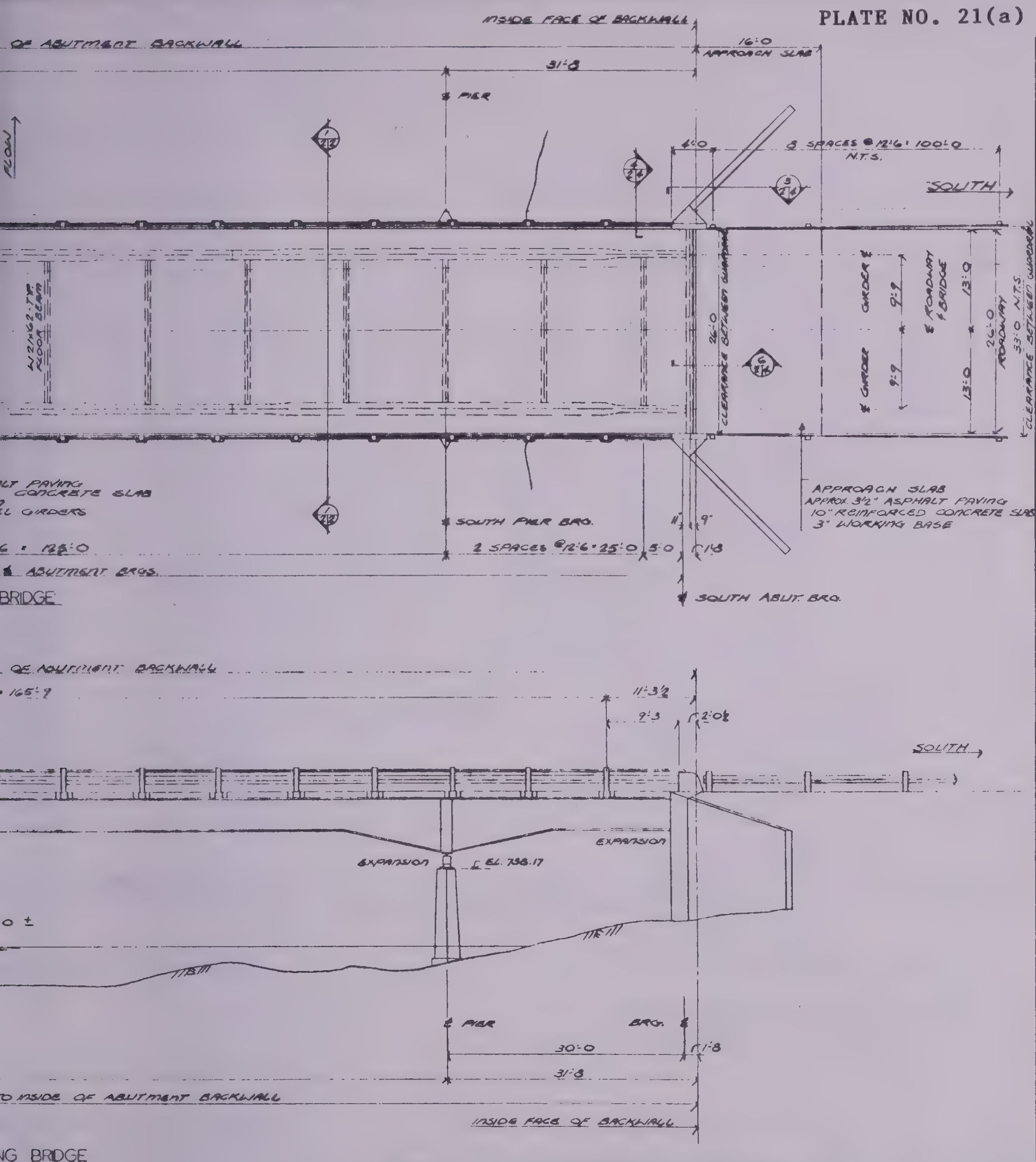


- 158'-9"
Finished grade elev. - 97.67
STRINGER 6" x 20"
Abutment Caps 6" x 8"
LU-LAM BEAMS 12¼" x 70" x 86'-0"
Elev. - 95.17
Elev. - 90.35
Elev. - 91.02
Elev. - 89.00
have been determined with respect to pier elevations.
should be checked in the field prior to construction
to possible settlement of old piers.
Approx. Ground Line
Out to out of Backwalls - 159'-10½"
84'-10½"
86'-0"
PLAN & ELEVATION
Brackets to secure cap to 'Glu-Lam Stringers 6 req'd.
SECTION B-B
Scale: ⅛" - 1'-0"
REVISIONS
PLANKA PLAINS BRIDGE
OVER ROSEAU RIVER
EAST OF SEC. 3-3-5 E.
P.T.H. 59 SOUTH
R.M. OF FRANKLIN
PROVINCE OF MANITOBA
HIGHWAYS BRANCH BRIDGE ENGINEER'S OFFICE
DEPARTMENT OF PUBLIC WORKS
Designed By
Drawn By
Traced By
Engineer In Charge
Checked By
Approved By
BRIDGE ENGINEER
CHIEF ENGINEER
Date
SCALE
SHEET NO.
PLAN NO. 2397





SECTION
SCALE: ¼"=1'-0



REVISIONS		
8 30 76	RN	AS BUILT DWG
DATE	BY	DESCRIPTION

SASAGIU RAPIDS BRIDGE DECK OVERLAY

41-09-313-49-01

PLAN AND ELEVATION OF EXISTING BRIDGE

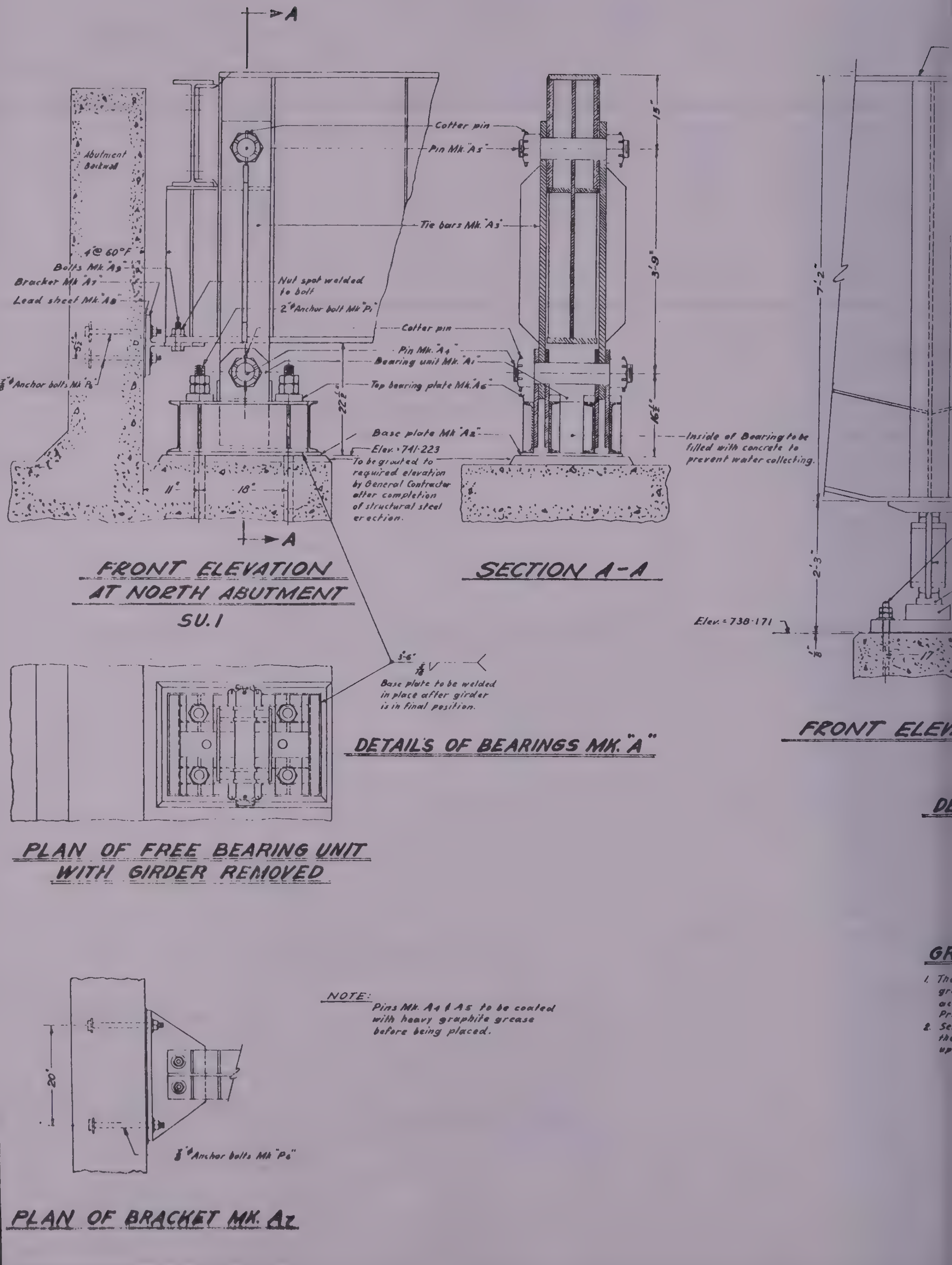
UNDERWOOD McLELLAN & ASSOCIATES LTD.
ENGINEERING & PLANNING CONSULTANTS
BRITISH COLUMBIA · ALBERTA · SASKATCHEWAN · MANITOBA · ONTARIO

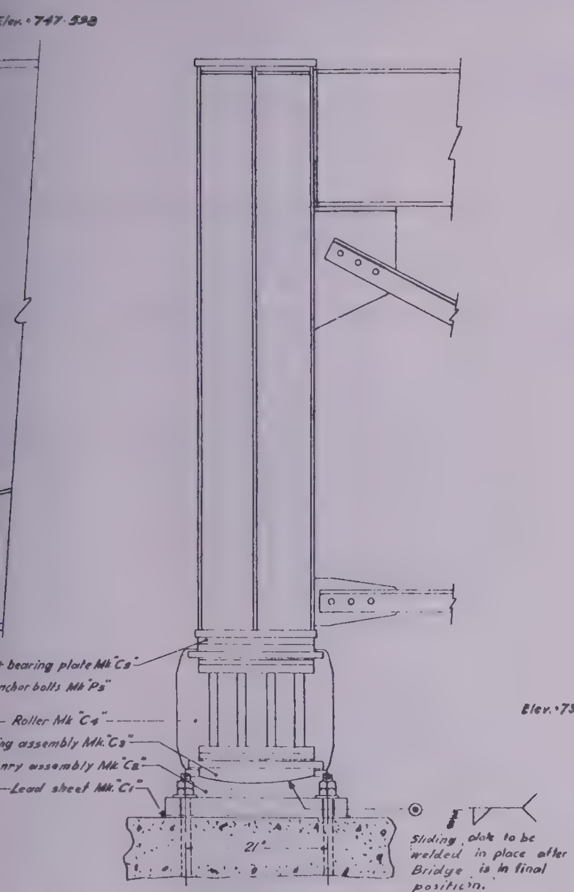
Province of Manitoba
The Highways Department
Bridge Division

Stamps: PROVINCE OF MANITOBA, L. F. YACHIMO, REGISTERED ENGINEER; PROVINCE OF MANITOBA, J. S. K., REGISTERED ENGINEER

PROJECT ENGINEER		
DESIGN	BY	J.S.K.
	CHECKED	L.F.Y.
DETAILS	BY	J.E.D.
	TRACED	
	CHECKED	J.S.K.

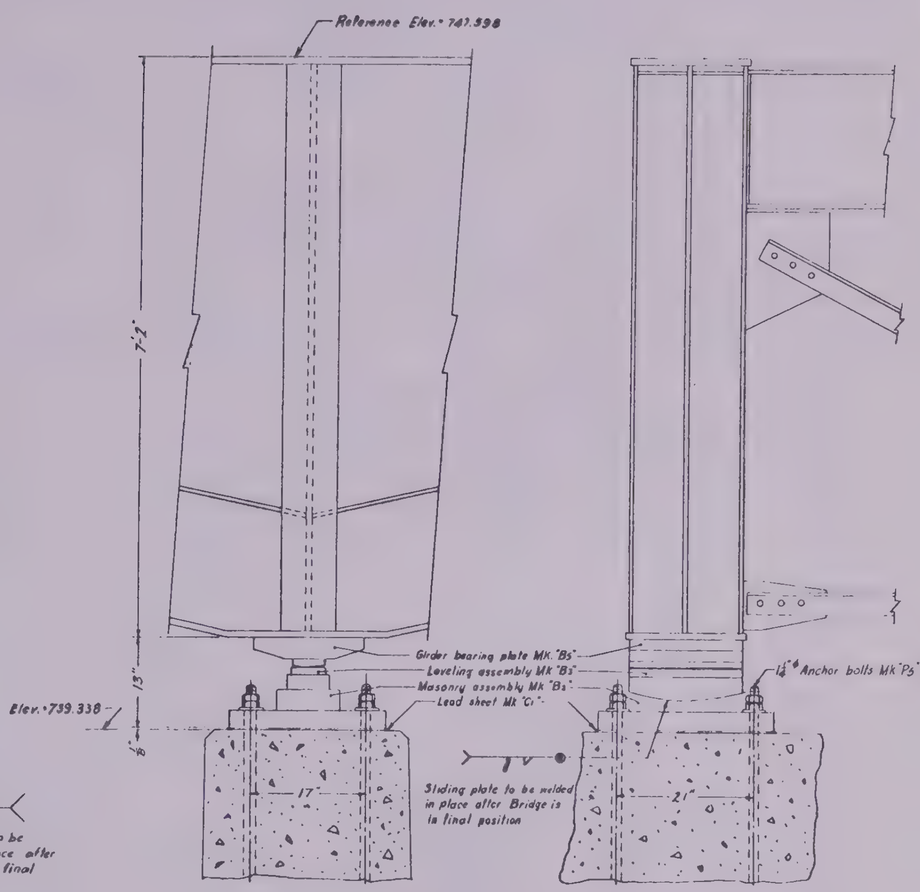
APPROVED BY: CHIEF BRIDGE ENGINEER — DATE 1976 08 12
SCALE: AS SHOWN
SHEET No. 2
PLAN No. 3067


A
A
Abutment Backwall
Cotter pin
Pin Mk. "A5"
Tie bars Mk. "A3"
4 @ 60° F
Bolts Mk. "A9"
Bracket Mk "A7"
Lead sheet Mk. "A8"
Nut spot welded to bolt
2" ⌀ Anchor bolt Mk "P1"
Cotter pin
Pin Mk. "A4"
Bearing unit Mk. "A1"
7/8" ⌀ Anchor bolts Mk "P6"
Top bearing plate Mk. "A6"
22 1/2"
Base plate Mk "A2"
Elev. = 741·223
To be grouted to required elevation by General Contractor after completion of structural steel erection.
11"
18"
1'5"
3'-9"
16 1/2"
Inside of Bearing to be filled with concrete to prevent water collecting.
7'-2"
2'-3"
Elev. = 738·171
FRONT ELEVATION AT NORTH ABUTMENT
SU.1
SECTION A-A
Base plate to be welded in place after girder is in final position.
DETAILS OF BEARINGS MK. "A"
FRONT ELEV
PLAN OF FREE BEARING UNIT WITH GIRDER REMOVED
NOTE: Pins Mk. A4 & A5 to be coated with heavy graphite grease before being placed.
20"
7/8" ⌀ Anchor bolts Mk "P6"
PLAN OF BRACKET MK. A7



V

SIDE ELEVATION



FRONT ELEVATION

SIDE ELEVATION

S OF BEARINGS MK. "C"

DETAILS OF BEARINGS MK. "B"

NG OF BEARING UNITS

f bearing units shall be
place by the General Contractor in
with the requirements of the Special
under the supervision of the Engineer.
after grouting bearing units in place
bolts shall be re-tightened to take
inkage in the grout.

REVISIONS

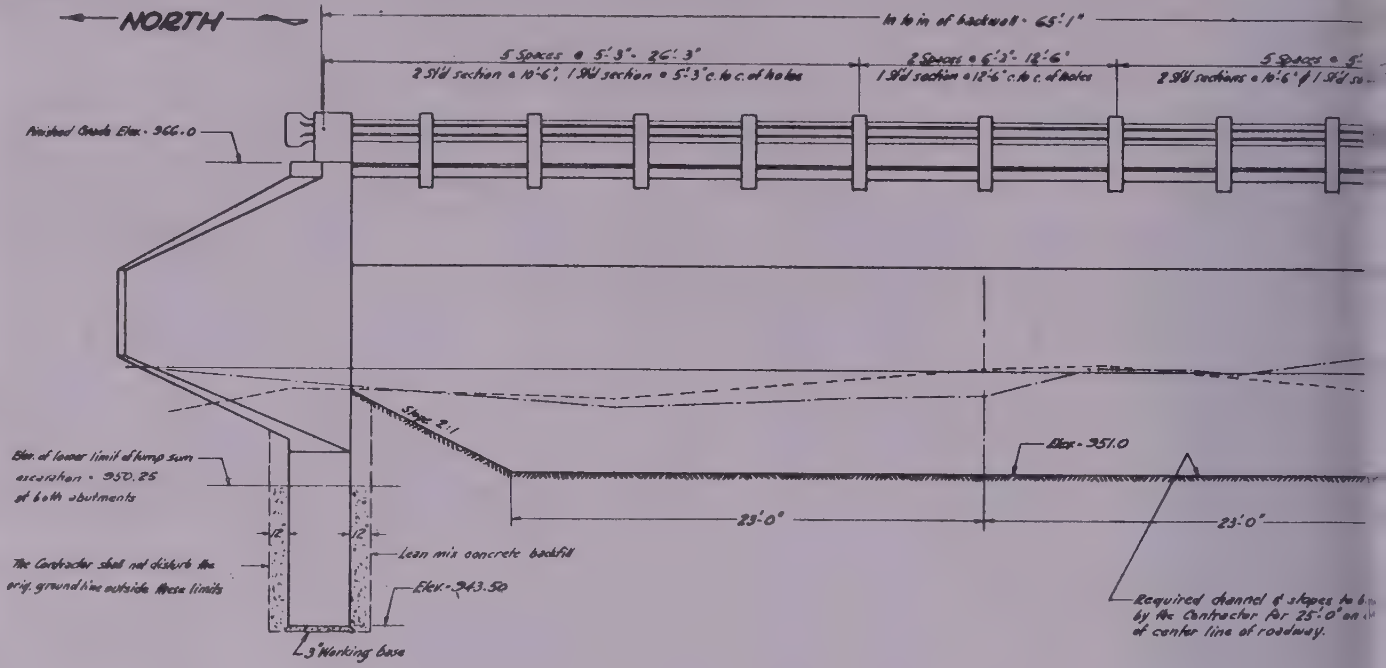
BEARING ASSEMBLY DETAILS
FOR 188'-0" STEEL & R.C. BRIDGE
OVER SASAGIU RAPIDS
ON WABOWDEN - THOMPSON RD. 26'-0" ROADWAY
MILE 17.7 FROM WABOWDEN T.W.P. 71, R.G.E. 7 W.

E.D. OF CHURCHILL

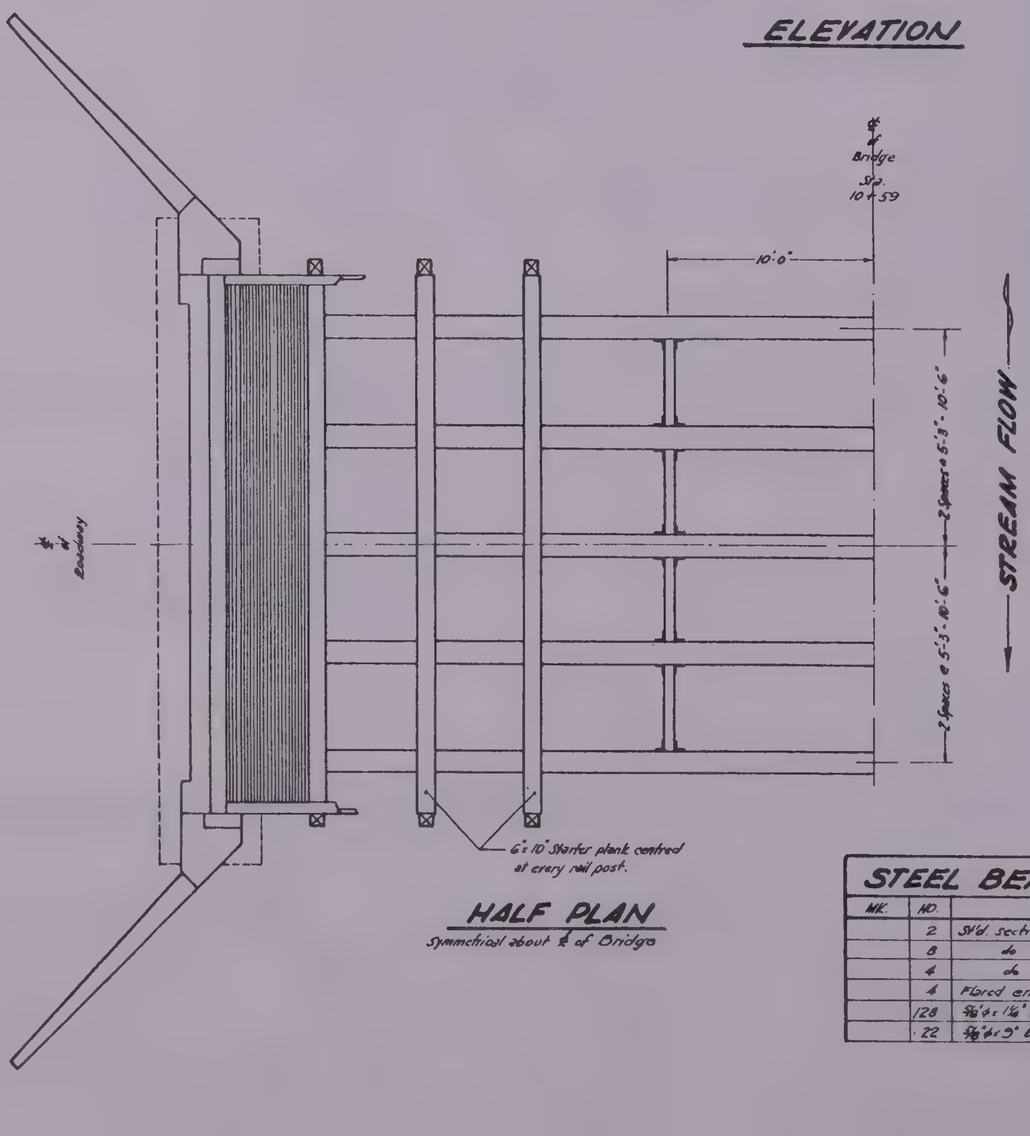
PROVINCE OF MANITOBA
HIGHWAYS BRANCH BRIDGE ENGINEER'S OFFICE
DEPARTMENT OF PUBLIC WORKS

Designed By J. H. B. Drawn By K. A. Traced By T. Z.
Engineer In Charge Checked By J. H. B. DAW.
Approved By CHIEF ENGR. DIRECTOR OF PLANNING
Date July 1960
SCALE 1"=1'-0" SHEET NO. 16/28 PLAN NO. 3067

J. H. BROWN
PROVINCE OF MANITOBA
REGISTERED ENGINEER



ELEVATION

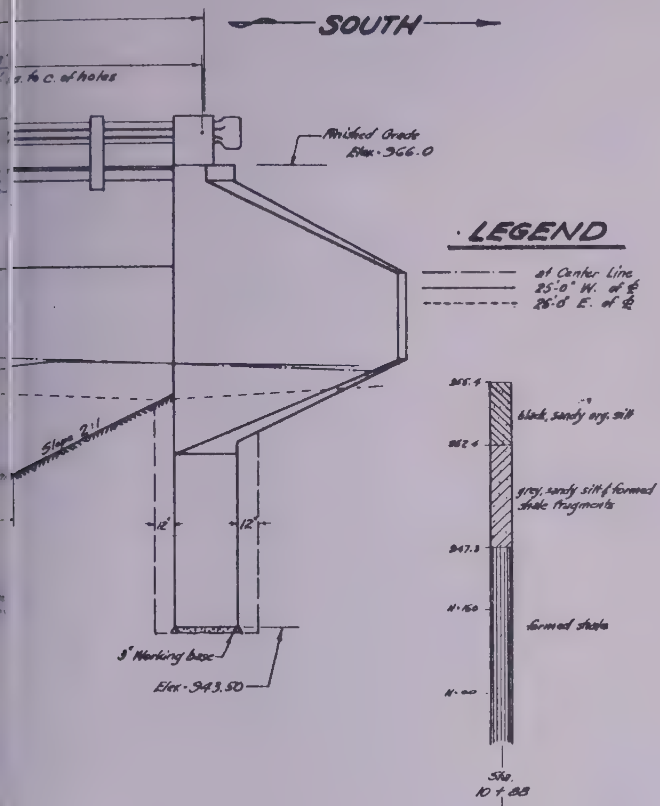


HALF PLAN

Symmetrical about ℄ of Bridge

STEEL BEAM GUARD RAI[G]		
MK.	NO.	DESCRIPTION
	2	St'd. sections 12'-6" c. to c of holes
	8	do 10'-6" do
	4	do 5'-3" do
	4	Flared ends
	128	5/8"φ x 1¼" bolts
	22	5/8"φ x 9" bolts

PLATE No. 22(a)



BILL OF TIM.

MK.	NO.	DESCRIPTION	SIZE	LENGTH	REMARKS	FBM.
A14	5	Glulam stringers	12¼" x 50⅝"	65'-0"	Coast Douglas Fir S4S	17,054
G1	11	Decking planks	6" x 10"	26'-3¼"	straight planks	1,445
H1	16	Diaphragms	6" x 20"	4'-2½"	" " field cut to fit	674
J1	8	Timber blocks	6" x 8"	2'-0"	straight planks, between deck & diaphragms	64
K2	22	Rail posts	8" x 8"	3'-6"	S4S., see Sheet 5/6	411
N1	2	Bottom bolster planks	4" x 12"	26'-3"	see Sheet 5/6	210
N2	2	upper bolster planks	4" x 12"	26'-3"	do	210
	450	Decking incl fascia &	2" x 6"	26'-0"	S4S	11,700
		edge screed				
					Total FBM. -	31,768

Timber to be rough unless otherwise noted in bill.

BILL OF BRIDGE IRON

PLAN NO. 3075

MK.	NO.	DESCRIPTION	SIZE	LENGTH	LOCATION	WT.
R1	60	Machine bolts	¾" ϕ	22"	Stringers & clips to abutment	179
R2	18	do	¾" ϕ	14"	Bottom bolster plank to abutment	36
R3	44	do	⅝" ϕ	9½"	Clip angles to deck planks	43
R4	88	do	⅝" ϕ	10"	Clip angles to rail posts	89
R5	4	do	⅝" ϕ	10½"	Flex beam to end posts	4
T1	18	C.I. (o.g.) washers	for ¾" ϕ bolts		1 to bolts R2	11
T2	88	do	for ⅝" ϕ bolts		1 to bolts R4	32
U1	60	Cut Washers	for ¾" ϕ bolts		1 to bolts R1	6
U2	180	do	for ⅝" ϕ bolts		2 to R3, 1 to R4 & R5	14
L1	20	Clip angles	6" x 8" x ½"	16½"	Stringers to abutments	633
L2	48	do	5" x 5" x ⅜"	20"	Diaphragms to stringers	984
L3	44	do	4" x 6" x ½"	7½"	Railposts to deck planks	446
X1	10	Lead sheets	17" x ¼"	25"	under stringers & angles	436
Y1		Common wire nails		10"	Decking planks to stringers	32
Y2		do		6"	Timber blocks to diaphragms top bolster plank to bottom.	12
Y3		do		3½"	Decking, fascia & edge screed	320
Z1	464	Lag screws	⅝" ϕ	6"	Angles to stringers	258
					Total weight lbs.	3,535

SUMMARY OF QUANTITIES

MATERIAL	QUANTITY	UNIT
Structural concrete	119.3	Cu. Yds
Cement 6½ bags/cu.yd.	780	Bags
Pozzolith ¼ lbs/bag	200	Lbs.
Treated timber	31,768	MFB.
Reinforcing steel	18,855	Lbs
Bridge iron	3,535	Lbs
Steel beam guard railing	130	Lin. Ft.
Heating concrete	119.3	Cu. Yds
Unit excavation & backfill	81	Cu. Yds.
Cement for lean mix concrete	220	Bags
Rub finish	450	sq. ft.

SHEET LEGEND

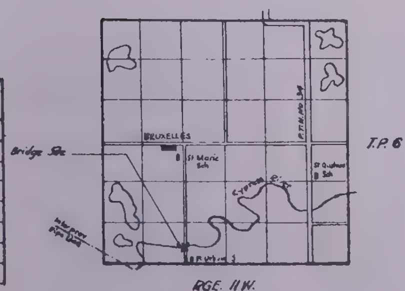
1. General Elevation
2. Abutment Concrete Details
3. Abutment Reinforcing
4. Wing Wall Details
5. Framing Details
6. Assembly Details

GENERAL NOTES

1. Log boring is supplied for general information only & the Department will not be held responsible for any errors or inaccuracies.
2. Rub finish: a) All faces of end posts.
   b) All exposed faces of wingwalls above ground line.

For fabrication details see Sheet No. 6/6

PLAN NO. 3075	
MARKS	WT.
Total weight lbs	1,145



LOCATION PLAN

REVISIONS

GENERAL ELEVATION

FOR 67'-1" T.T. & R.C. BRIDGE

OVER CYPRESS RIVER ON MUNICIPAL RD.

E. OF SEC. 5-6-11W. 26'-0" ROADWAY

R.M. OF LORNE

PROVINCE OF MANITOBA

HIGHWAYS BRANCH BRIDGE ENGINEER'S OFFICE

DEPARTMENT OF PUBLIC WORKS

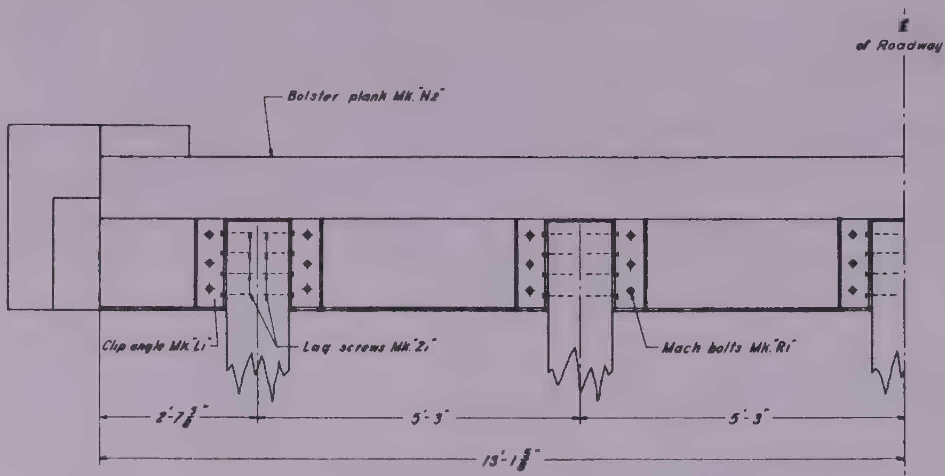
Designed By A.L. Drawn By I.G. Traced By T.E.

Engineer In ... Checked By ...

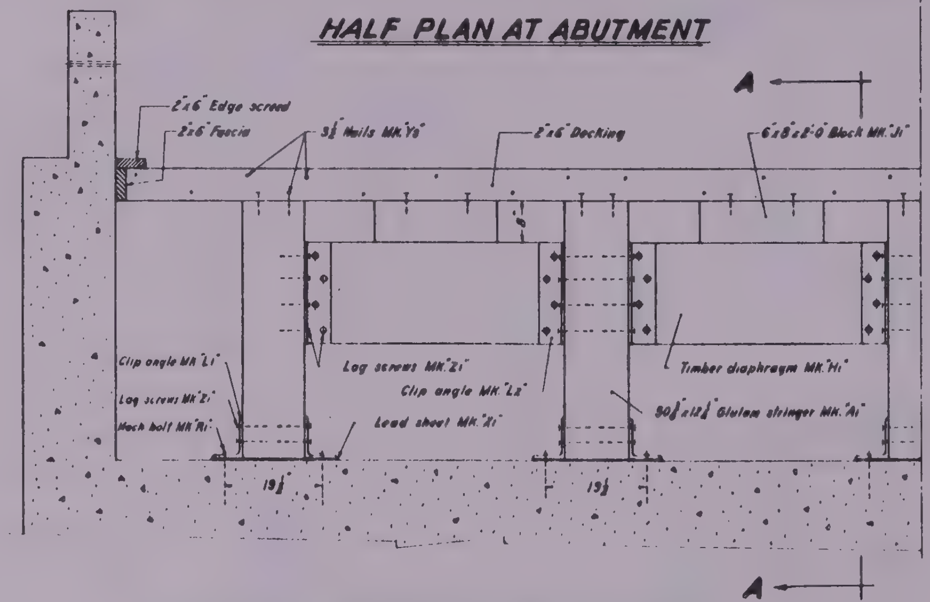
Approved ... ENGINEER ... CHIEF ENGINEER

Date JANUARY 1960

SCALE ⅛" = 1'-0" SHEET NO. 1/6 PLAN NO. 3075

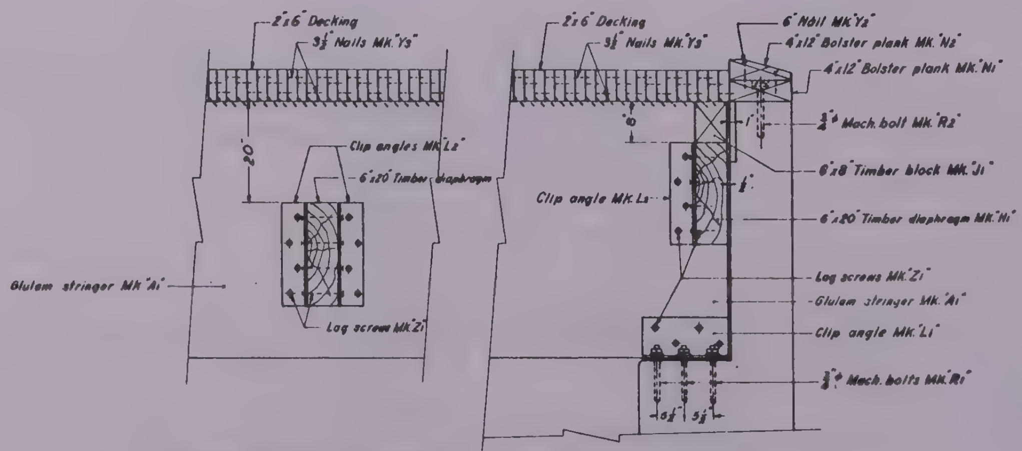


HALF PLAN AT ABUTMENT



HALF CROSS SECTION AT ABUTMENT

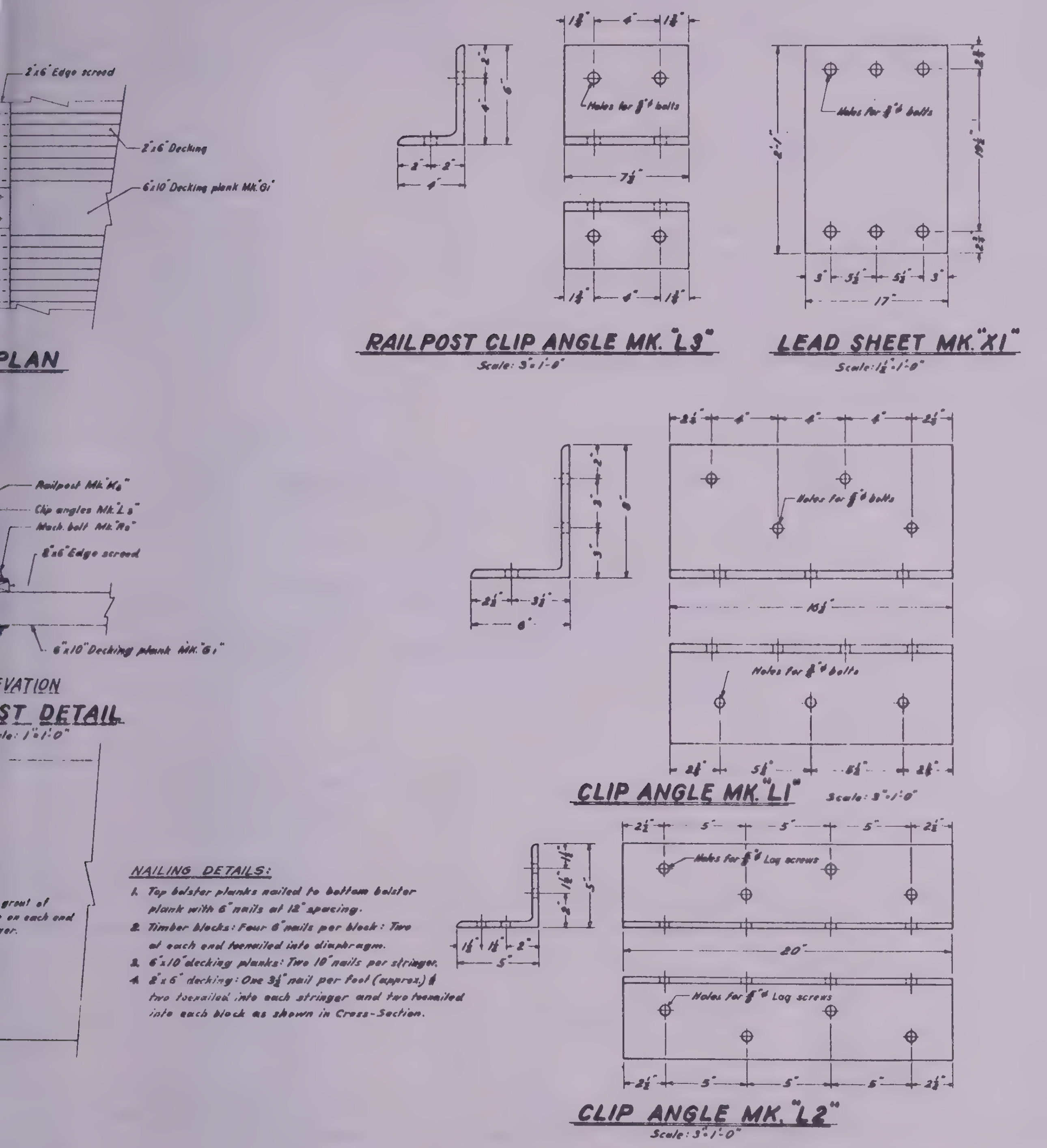
Showing diaphragms



INTERMEDIATE DIAPHRAGM

END DIAPHRAGM

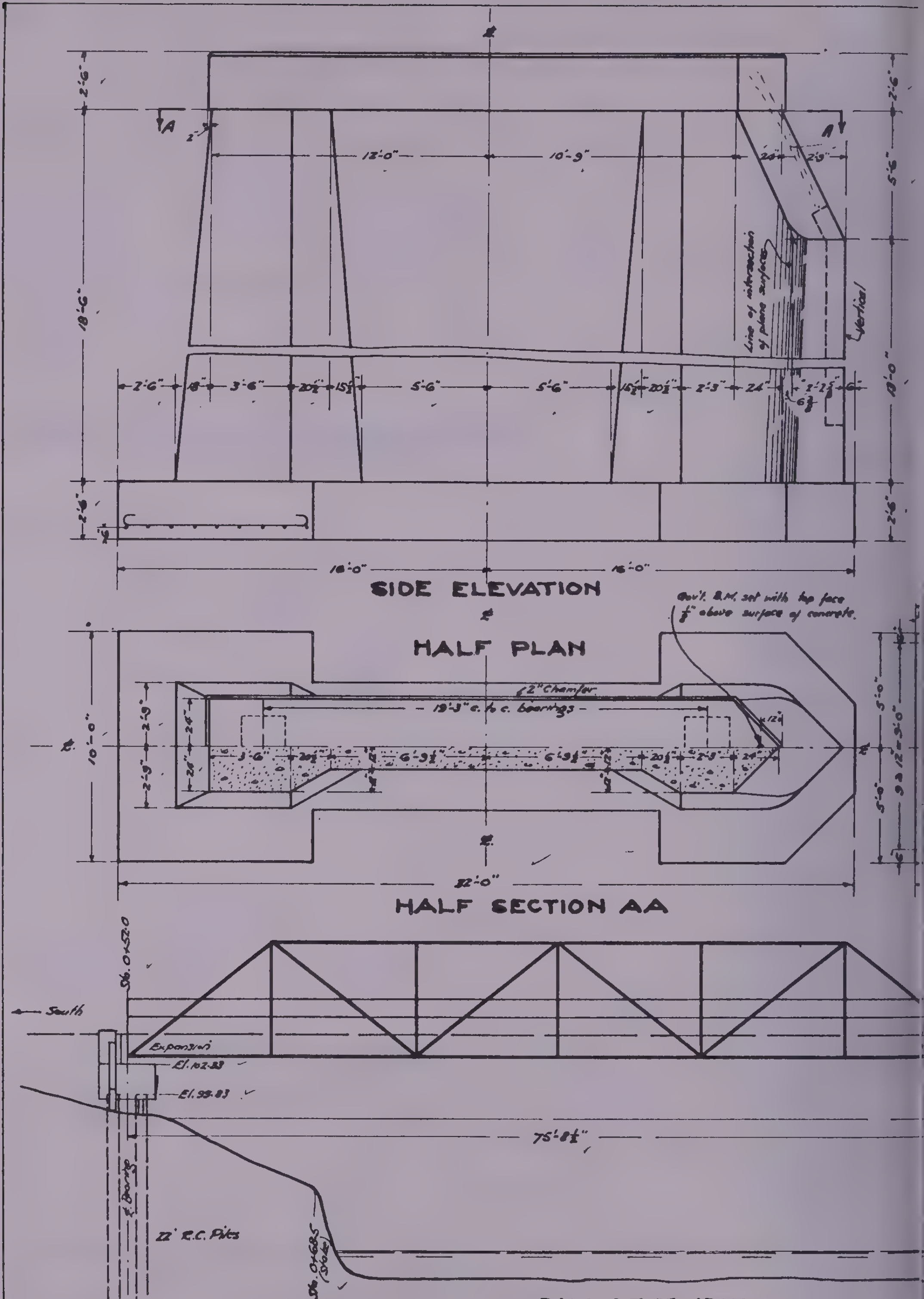
SECTION "A-A"



NAILING DETAILS:

1. Top bolster planks nailed to bottom bolster plank with 6" nails at 12" spacing.
2. Timber blocks: Four 6" nails per block: Two at each end toenailed into diaphragm.
3. 6"x10" decking planks: Two 10" nails per stringer.
4. 2"x6" decking: One 3½" nail per foot (approx.) & two toenailed into each stringer and two toenailed into each block as shown in Cross-Section.

REVISIONS	ASSEMBLY DETAILS
	FOR 67'-1" T.T. & REINF. CONCRETE BRIDGE OVER CYPRESS RIVER ON MUNICIPAL ROAD E. OF SEC. 5-6-11W. 26'-0" ROADWAY
	R.M. OF LORNE
	PROVINCE OF MANITOBA HIGHWAYS BRANCH BRIDGE ENGINEER'S OFFICE DEPARTMENT OF PUBLIC WORKS
	Designed By A.L. Drawn By I.G. Traced By L.M.
	Engineer in Charge ____ Checked By W.D.
	Approved By [signature] Act. BRIDGE ENGINEER [signature] CHIEF ENGINEER
	Date January 1960
	SCALE 3/8"=1'-0" Or as shown SHEET NO. 6/6 PLAN NO. 3075

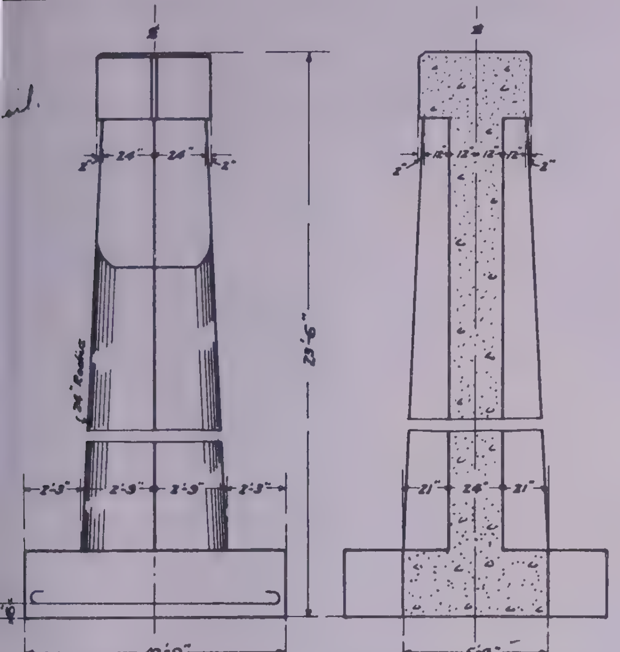


BILL OF TIMBER

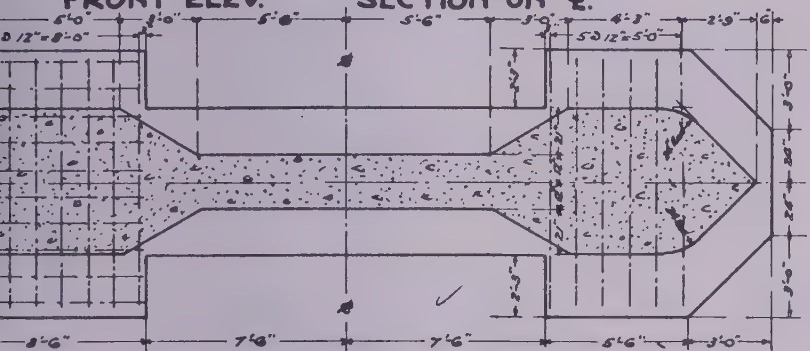
To be supplied by Contractor for Superstructure.

No.	Description	Size	Length	Remarks	F.B.M.
48	Nailing strips	3"×8"	12'	Rough	1152
14	Blocking	2"×6"	12'	"	168
1000	Flooring	2"×4"	18'	S.1S1E	12000
24	"	4"×8"	18'	"	1152
2	"	5"×8"	18'	Rough	120
24	Guard rail	4"×6"	14'	S.1S.1E	672
10	Risers	1"×6"	12'	Rough	60
2	Ballast timbers	8"×12"	18'	"	288

Total 15612



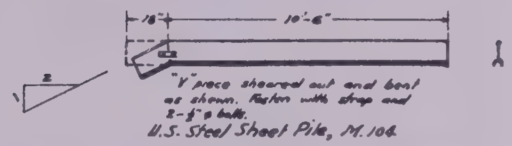
FRONT ELEV. SECTION ON ℄.



SECTION AT TOP OF FOOTING

BILL. OF BA PLATE No. 23(a)

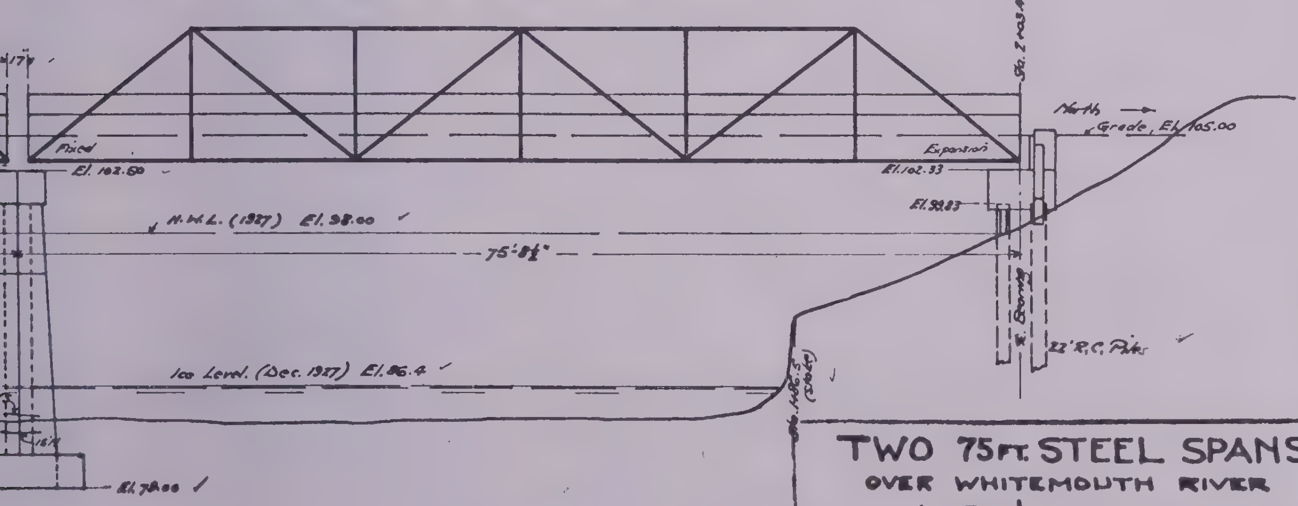
No.	Size	Length	Sketch	Weight
15	$\frac{5}{8}$" φ	11'-0"	6" — 9'-5" — 6"	172
10	$\frac{5}{8}$" φ	9'-6"	6" — 7'-11" — 6"	99
All bars to be of approved deformed type and of intermediate grade.			Total lb.	271



DETAIL OF NOSE PIECE
1 Reqd. and supplied by the Mun'y.

APPROX. QUANTITIES

Excavation.	Pier	75	cu.yd.
	Abutments	5	"
Concrete.	Pier	92	"
	Abutments	20.5	"
Cement.	Pier	139	bbl.
	Abutments	53	"
R.C. Piling.	Abutments	352	lin.ft.
Reinf. Steel	Pier	271	lb.
	Abutments	979	"
Nose Piece. 1 U.S. steel sheet pile M.104, 12' long, supplied by Mun'y			
Timber		15612	f.b.m.
Steel Truss Spans, Std. a-43		40	tons
Steel deck plates, bolts & bevel washers		470	lb.
122 Hook Bolts & C.I. Washers - Guard Rails		362	"
96 " " & Curb " - 4"×8"		120	"
240 Bolts through stringers		136	"
3½" Wire nails		300	"
Tarvia "X"		380	gal.
Gravel for floor, maximum ½"		4	cu.yd.
" " " ½" to 1½"		12	"



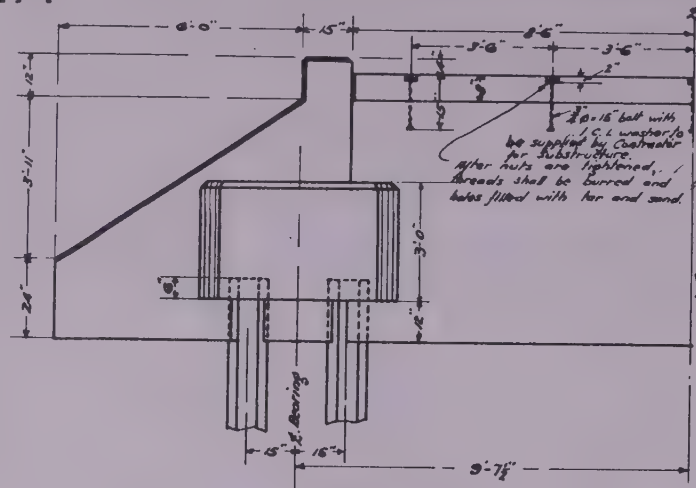
M ELEVATION
℄ Profile
le ⅛"=1'

NOTE:– In order to bond successive courses, thoroughly saturated bevelled wooden strips of 2"×4" shall be used to form suitable keys at the top of the upper layer of each days work.

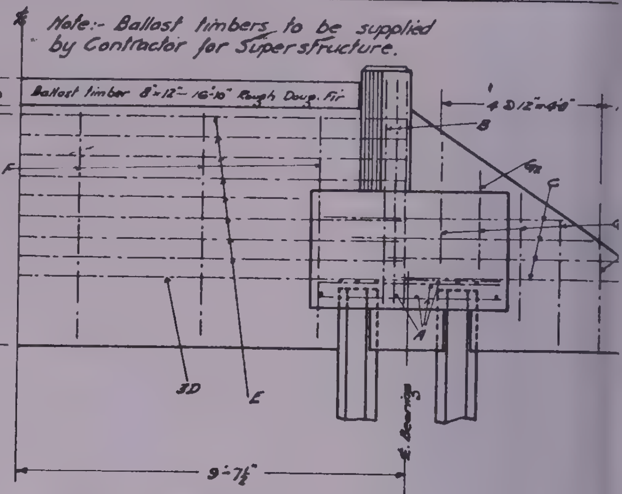
TWO 75 FT. STEEL SPANS
OVER WHITEMOUTH RIVER
IN SE¼. 15-12-11E
WHITEMOUTH MUN.

DEPARTMENT OF PUBLIC WORKS
GOOD ROADS BOARD
MANITOBA

Designed by A.J.T. Drawn by A.J.T. Traced by A.J.T.
Engineer in Charge A.J. Taunton Checked by C.P.W.
Approved by M. A. Lyons ... Chief Engineer
Date Dec. 1927
SCALE ¼"&⅛"=1' SHEET NO. 3/4 PLAN NO. 1470

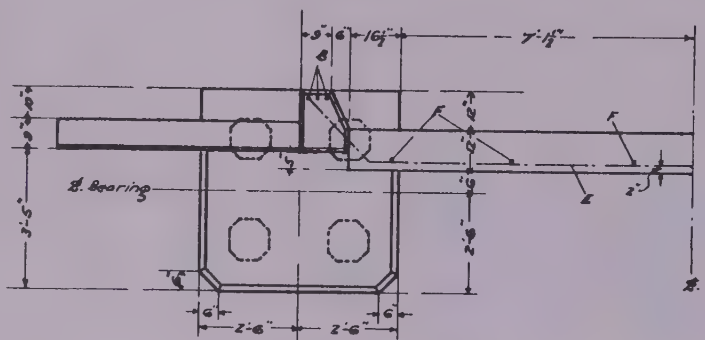


HALF FRONT ELEV.

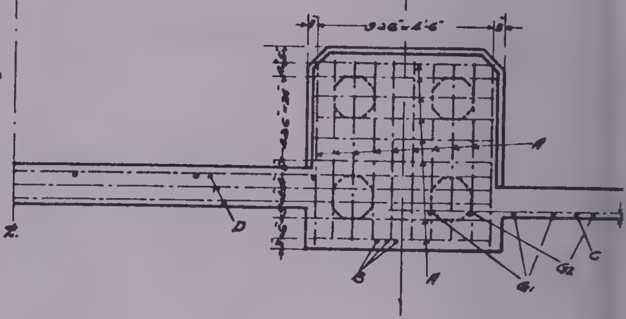


HALF REAR ELEV.

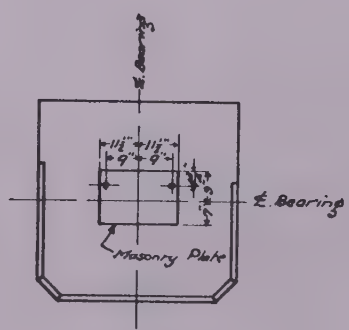
Symmetrical about ℄



HALF PLAN



SECTION AA



PLAN OF BRIDGE SEAT

LOCATION PLAN

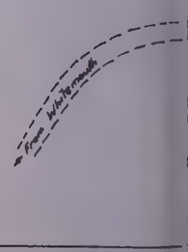
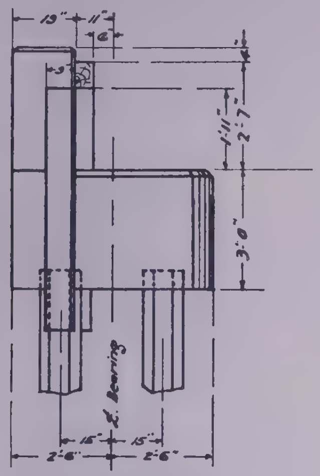
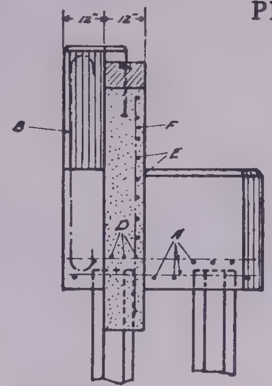


PLATE No. 23(b)



SIDE ELEV.



SECT. ON ℄.

Date Figures:–
Figures "1928", 4" high, formed with metal moulds, to be placed on E. side of S. abut. and on W. side of N. abut.

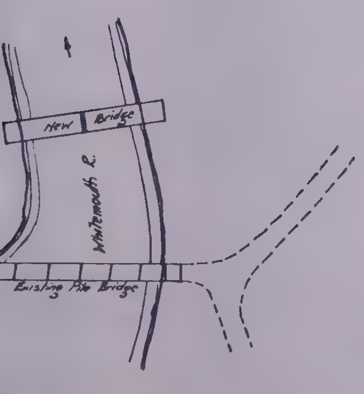
BILL OF BARS
FOR TWO ABUTMENTS

Mark	No.	Size	Length	Sketch	Weight
A	72	½"φ	7'-0"	6" 6" — 4'-6" —	337
B	12	½"φ	8'-0"	6" 6" — 5'-6" —	64
C	16	½"φ	6'-0"	Straight	64
D	6	¾"φ	23'-9"	Straight	214
E	16	½"φ	20'-6"	— 16'-8" —	219
F	12	½"φ	5'-6"	Straight	44
G1	12	½"φ	3'-0"	Straight	24
G2	8	½"φ	2'-6"	Straight	13
All bars to be of approved deformed type and of intermediate grade.				Total lb.	979

R.C. Piles to be 22 ft. in length and constructed according to Std. Plan C-70, being Sheet 2 of this set.

Approx. Quantities for Two Abutments :–

R.C. Piles	16-22 ft. = 352 lin. ft.
Concrete	20.5 cu. yd.
Excavation	5 "
Cement	53 bbl.

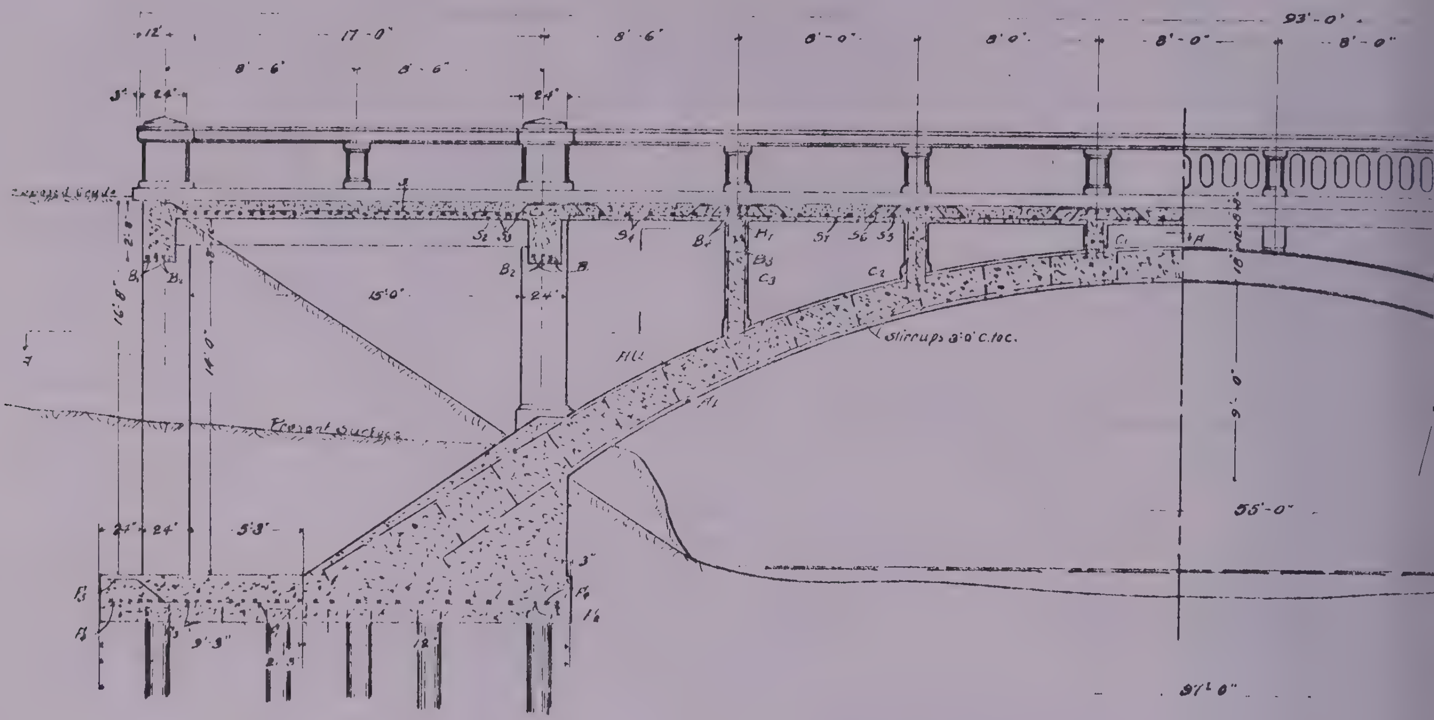


PLAN OF SITE
Scale 1" = 50'

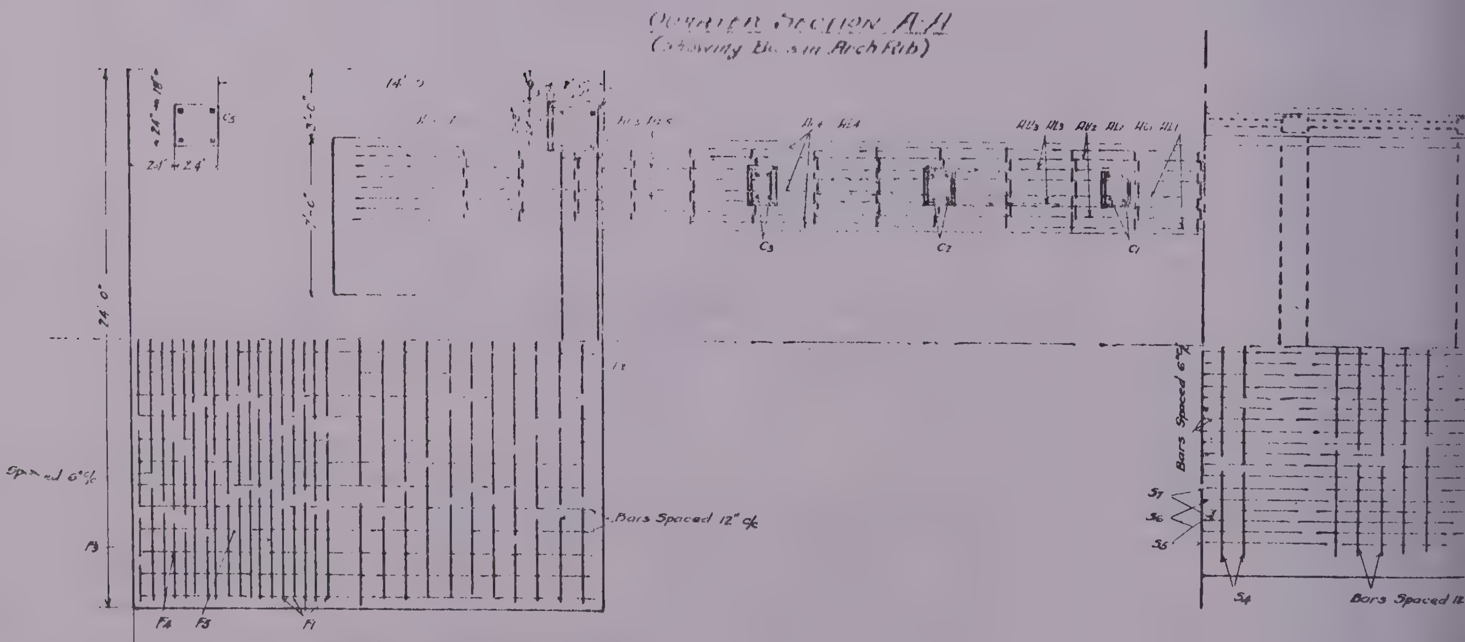
R.C. PILE ABUTMENTS
IN SE¼ 15-12-11 E.
MUN. OF WHITEMOUTH

DEPARTMENT OF PUBLIC WORKS
GOOD ROADS BOARD
MANITOBA

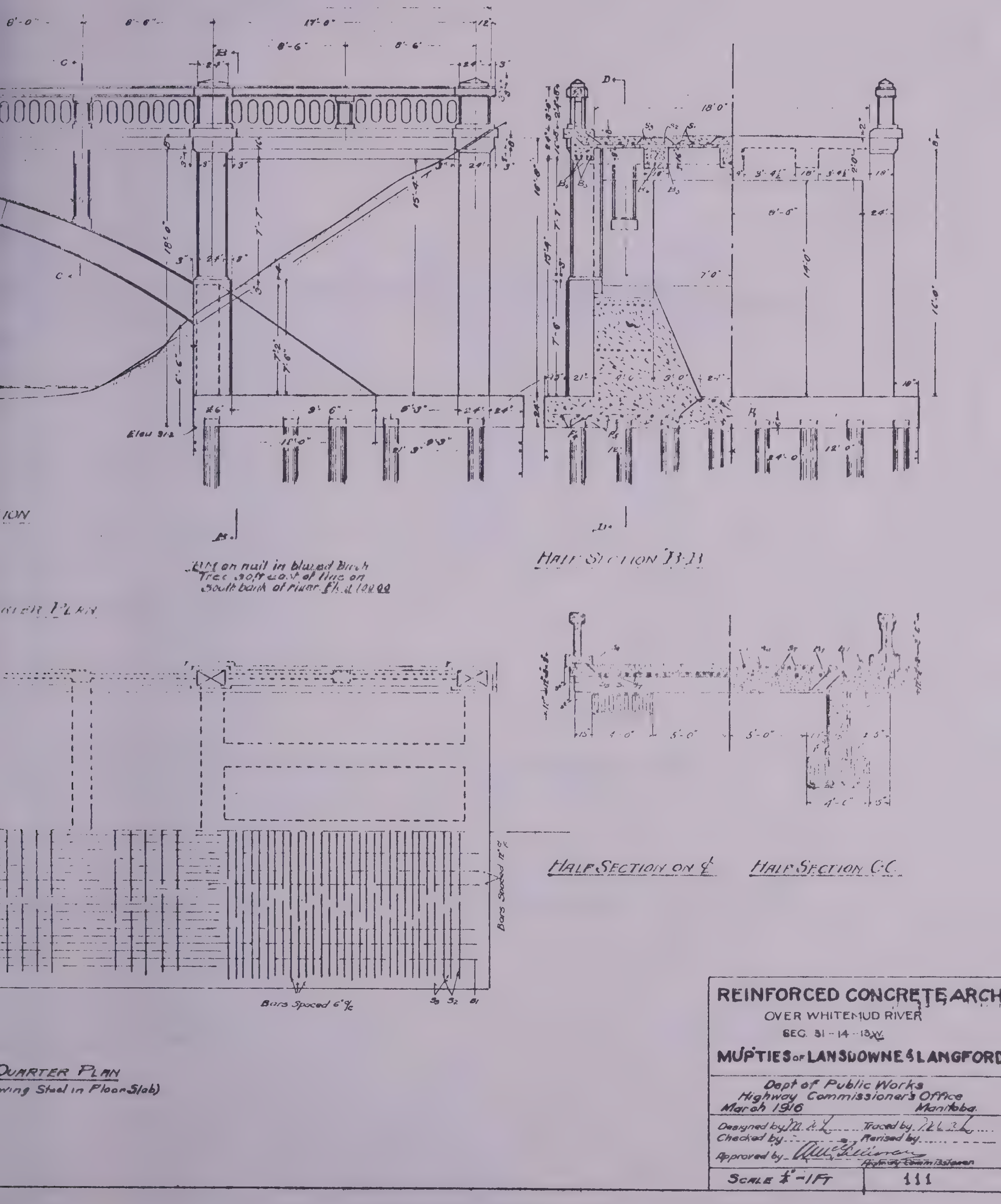
Designed by A.J.T. Drawn by A.J.T. Traced by A.J.T.
Engineer in Charge A.J. Taunton Checked by N.B.M.
Approved by .... Chief Engineer
Date Dec. 1927
SCALE 3/8" = 1' SHEET No. 1/4 PLAN No. 1470

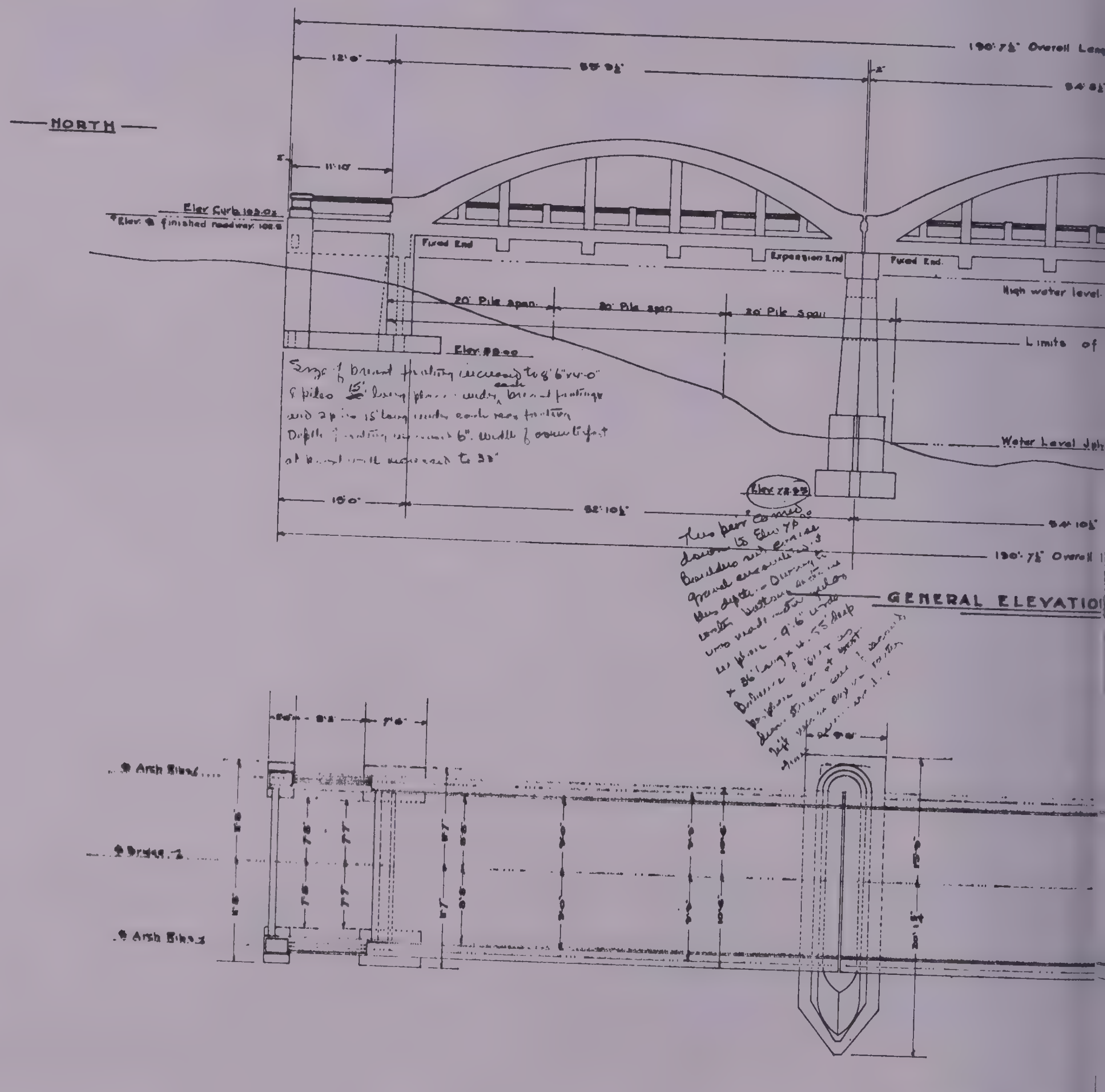


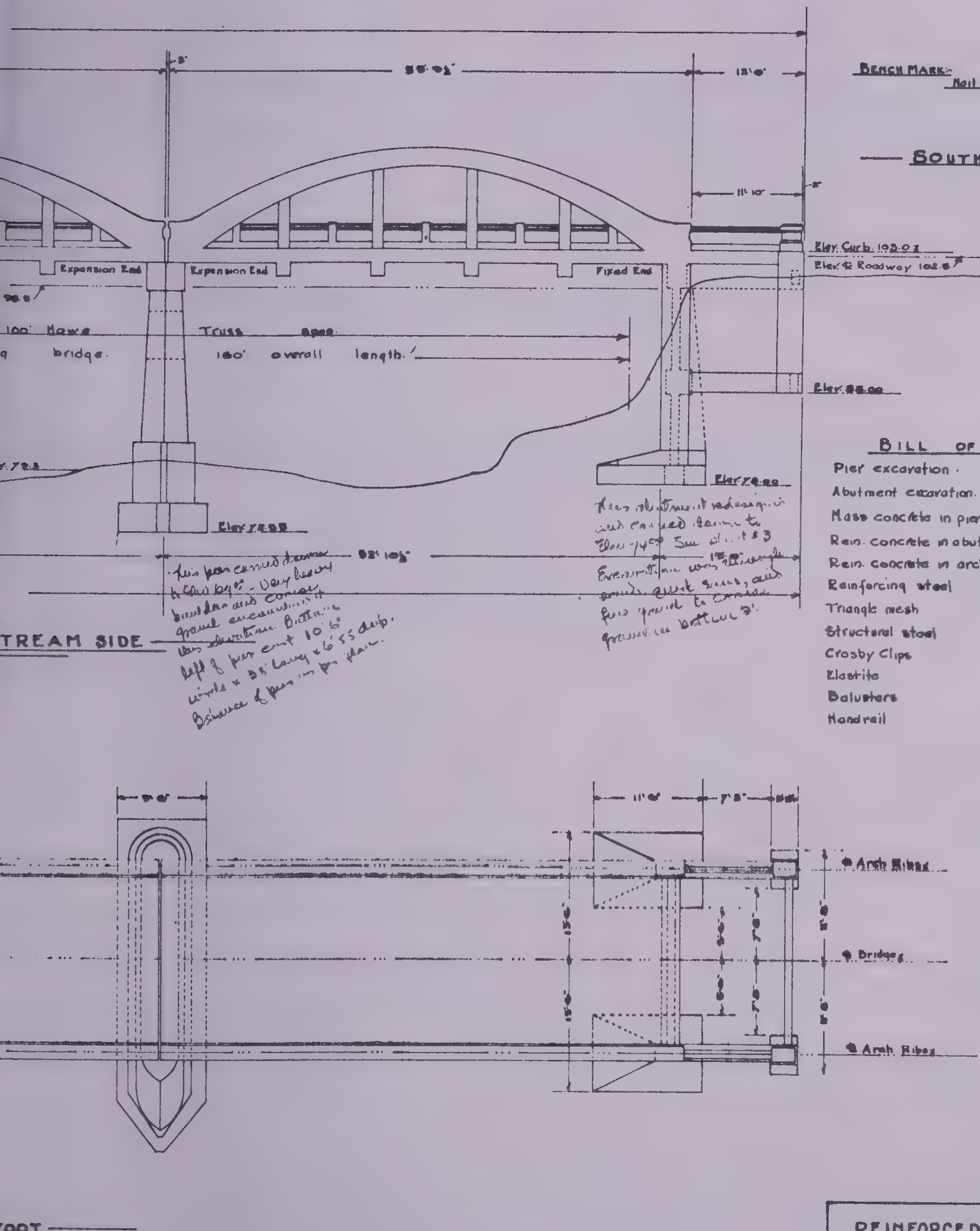
HALF SECTION "D-D"



QUARTER PLAN
(Showing Steel in Footings)


B.M. on nail in blazed Birch Tree 30ft east of line on south bank of river. El. 100.00
Elev 91.2
HALF SECTION B-B
HALF SECTION ON ℄
HALF SECTION C-C
Bars Spaced 12" c/c
Bars Spaced 6" c/c
QUARTER PLAN
(Showing Steel in Floor Slab)
REINFORCED CONCRETE ARCH
OVER WHITEMUD RIVER
SEC. 31 - 14 - 13 W.
MUN'TIES OF LANSDOWNE & LANGFORD
Dept of Public Works
Highway Commissioner's Office
March 1916
Manitoba
Designed by M. & L.
Traced by M. & L.
Checked by
Revised by
Approved by
Highway Commissioner
SCALE 1/4" - 1 FT
111


NORTH
GENERAL ELEVATION
GENERAL PLAN
SCALE ONE EIGHTH INCH =
Fixed End
Expansion End
High water level
Limits of
Water Level
20' Pile span
Arch Ribs
Bridge



BILL OF QUANTITIES

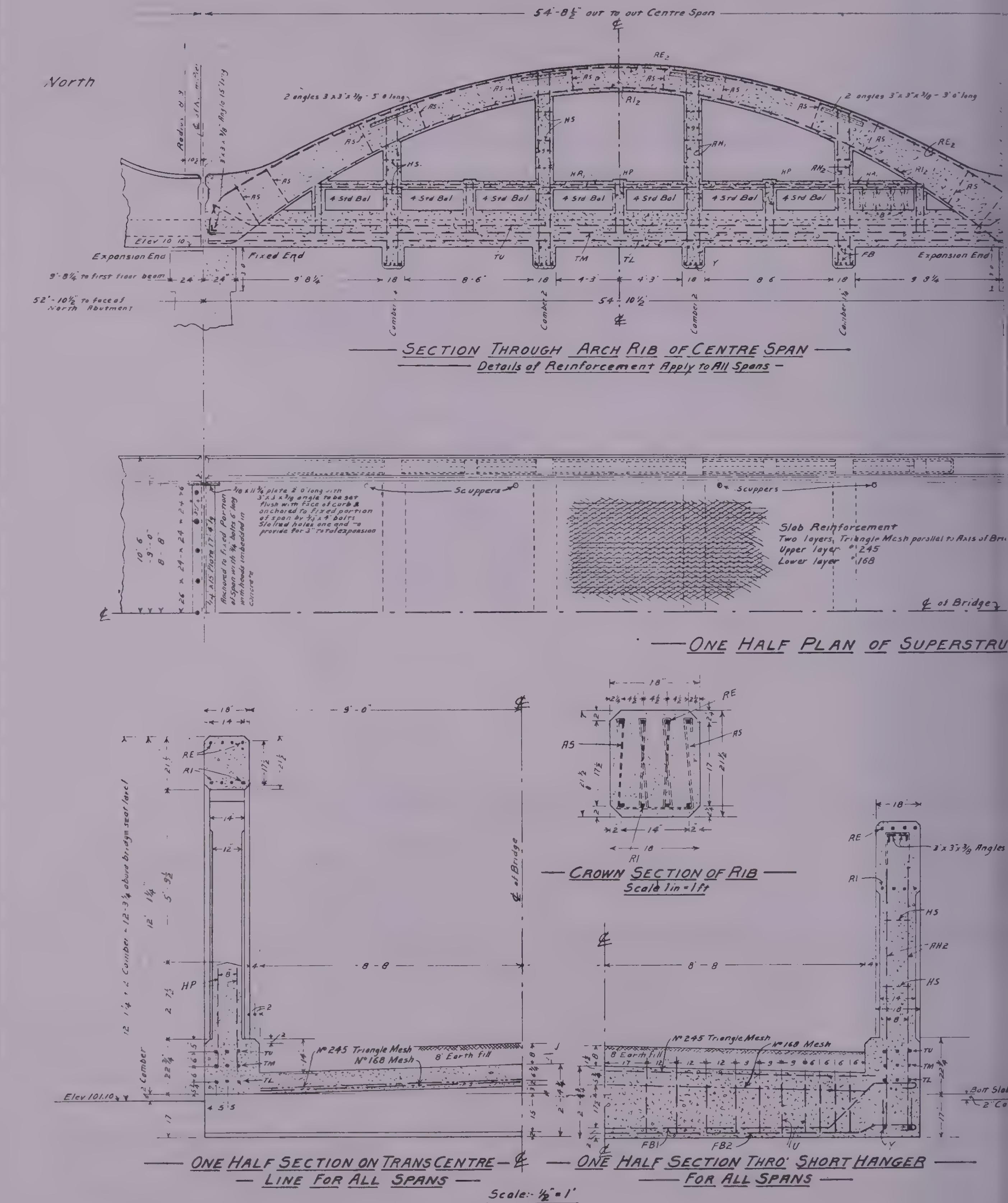
Pier excavation.	approx. 210 cu yds.
Abutment excavation.	" 253 "
Mass concrete in piers	277 "
Rein. concrete in abutments	103 "
Rein. concrete in arches	205 "
Reinforcing steel	45521 lbs.
Triangle mesh	6624 sq. ft.
Structural steel	5040 lbs.
Crosby Clips	300 only.
Elastite	11 sq. ft.
Balusters	238 only.
Handrail	230 lin ft.

REINFORCED CONCRETE BRIDGE
OVER SOURIS RIVER
E·5·3·16·W
SOUTH CYPRESS MUNICIPALITY

Dept. of Public Works
Highway Commissioners Office
May 1920 Manitoba.

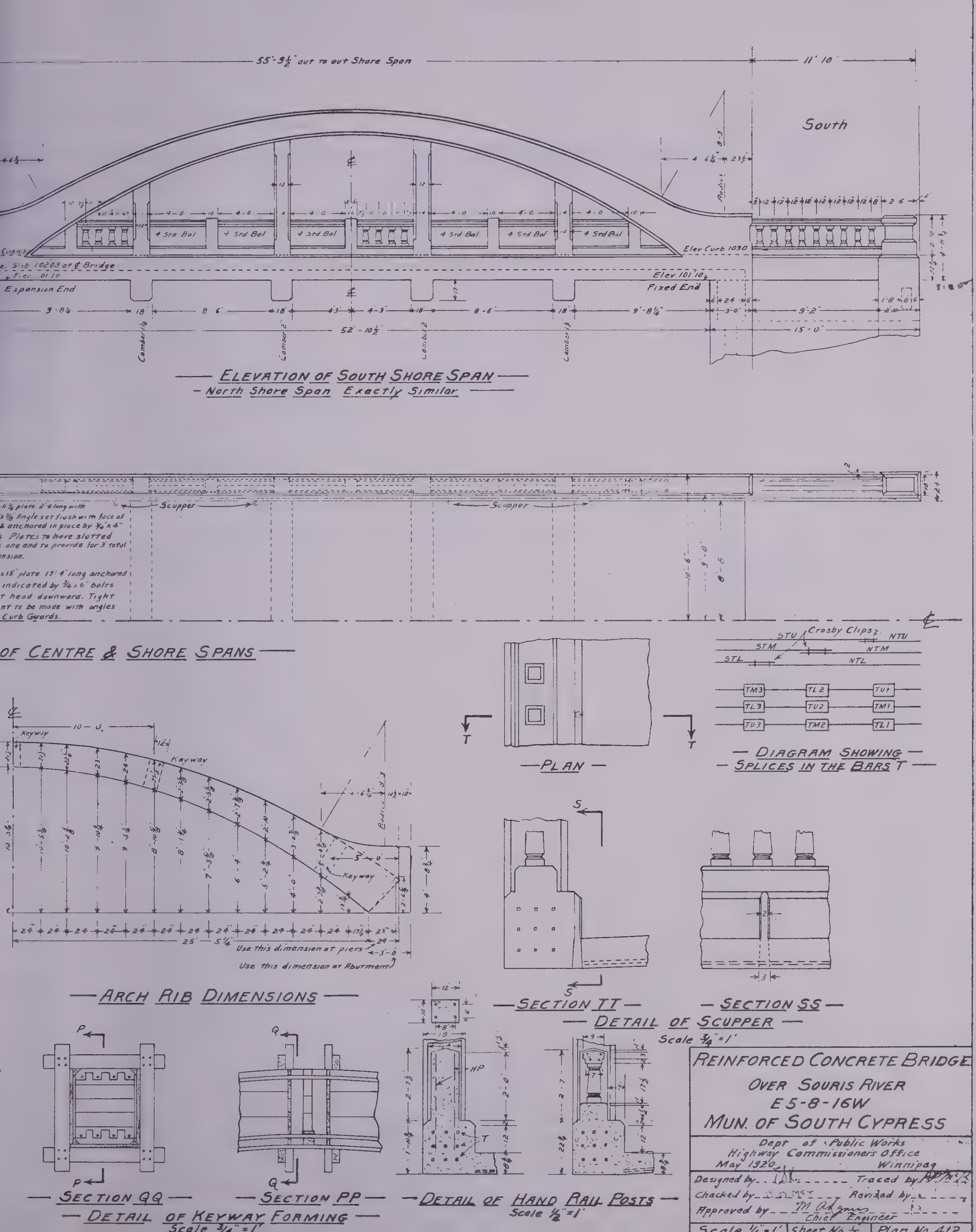
Designed by ...... Traced by ......
Checked by ...... Revised by ......
Approved by ...... Chief Engineer.

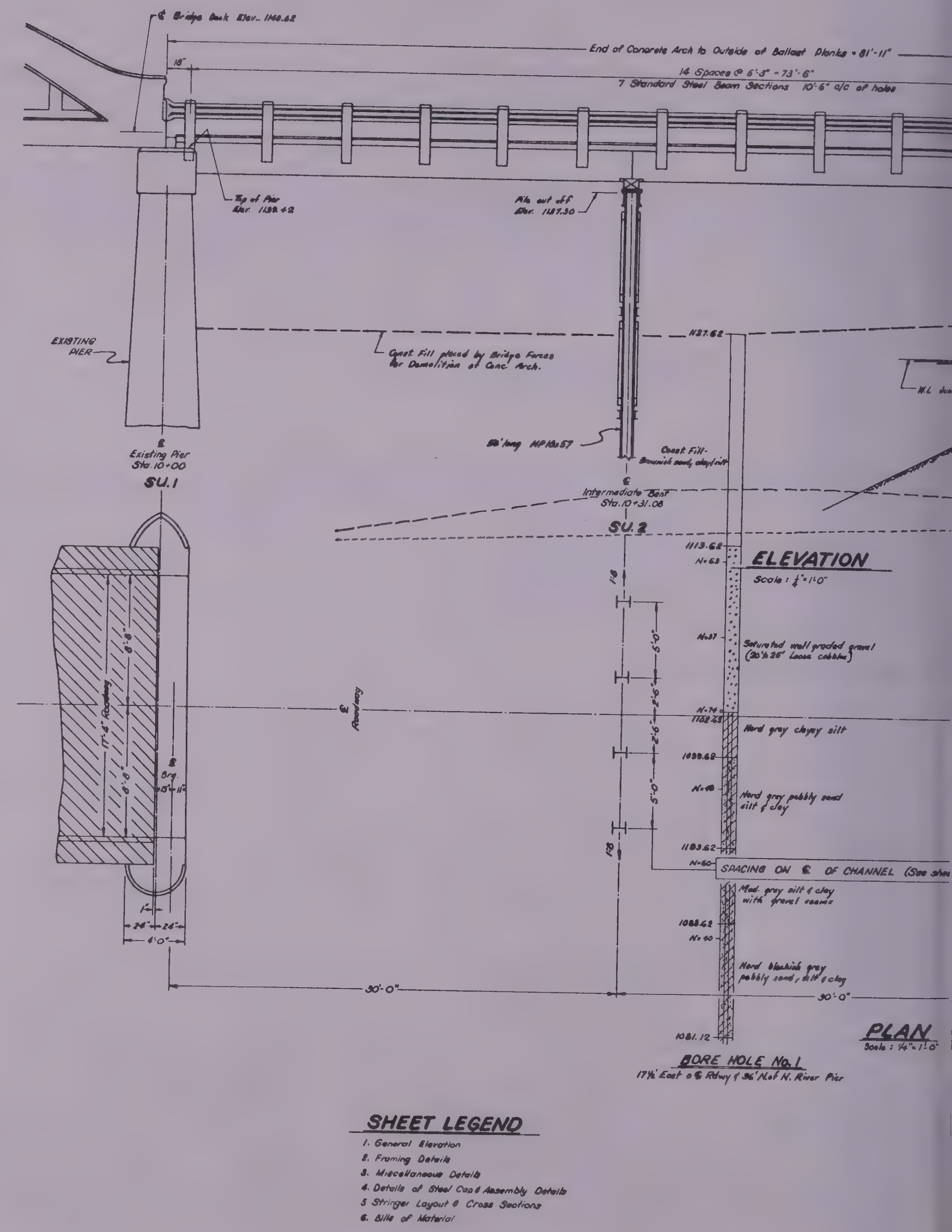
SCALE ⅛ IN = 1 FOOT SHEET Nº ¾ PLAN Nº 412



54'-8½" out to out Centre Span
North
2 angles 3 x 3" x ⅜ - 5' 0 long
2 angles 3" x 3" x ⅜ - 5' 0" long
4 Std Bal
Expansion End
Fixed End
Expansion End
9'-8¼ to first floor beam
52'-10½ to face of North Abutment
54'-10½"
SECTION THROUGH ARCH RIB OF CENTRE SPAN
Details of Reinforcement Apply to All Spans
Scuppers
Slab Reinforcement
Two layers, Triangle Mesh parallel to Axis of Bri
Upper layer #245
Lower layer #168
℄ of Bridge
ONE HALF PLAN OF SUPERSTRU
CROWN SECTION OF RIB
Scale 1 in = 1 ft
№ 245 Triangle Mesh
№ 168 Mesh
8" Earth fill
Elev 101.10
ONE HALF SECTION ON TRANS CENTRE LINE FOR ALL SPANS
ONE HALF SECTION THRO' SHORT HANGER FOR ALL SPANS
Scale:- ½" = 1'

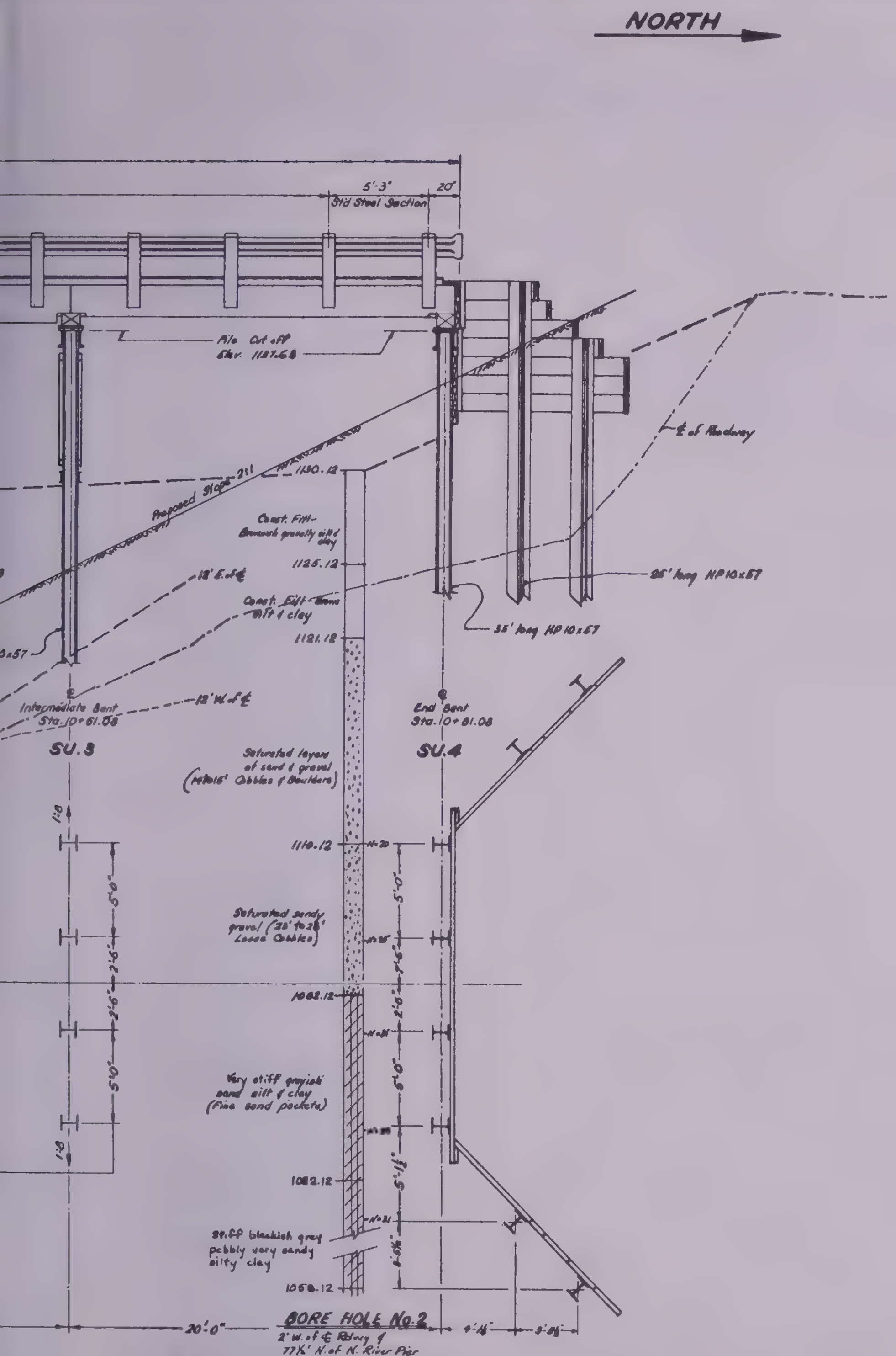
PLATE No. 25(b)

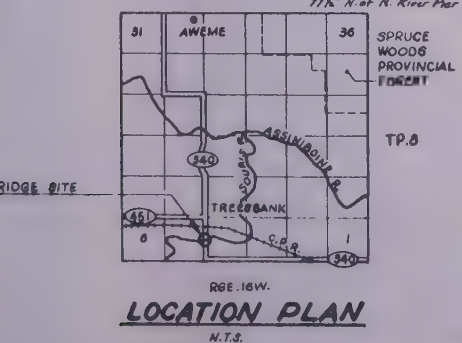

55'-9½" out to out Shore Span
11' 10"
South
4 Std Bal
Elev Curb 1030
Elev 1017 10
Fixed End
Expansion End
52'-10½"
15'-0"
Camber 1¼
Camber 2"
Camber 2
Camber 1½
— ELEVATION OF SOUTH SHORE SPAN —
— North Shore Span Exactly Similar —
Scupper
OF CENTRE & SHORE SPANS —
Crosby Clips
STU
STM
STL
NTU
NTM
NTL
TM3
TL2
TU1
TL3
TU2
TM1
TU3
TM2
TL1
— DIAGRAM SHOWING —
— SPLICES IN THE BARS —
— PLAN —
Keyway
Use this dimension at piers
Use this dimension at Abutment
— ARCH RIB DIMENSIONS —
— SECTION TT —
— SECTION SS —
— DETAIL OF SCUPPER —
Scale ¾"=1'
— SECTION QQ —
— SECTION PP —
— DETAIL OF KEYWAY FORMING —
Scale ¾"=1'
— DETAIL OF HAND RAIL POSTS —
Scale ½"=1'
REINFORCED CONCRETE BRIDGE
OVER SOURIS RIVER
E 5-8-16W
MUN. OF SOUTH CYPRESS
Dept of Public Works
Highway Commissioners Office
May 1920
Winnipeg
Designed by
Traced by
Checked by
Revised by
Approved by
M Adams
Chief Engineer
Scale ¼"=1'
Sheet No
Plan No 412



℄ Bridge Deck Elev. 1140.62
End of Concrete Arch to Outside of Ballast Planks = 81'-11"
14 Spaces @ 5'-3" = 73'-6"
7 Standard Steel Beam Sections 10'-6" c/c of holes
Top of Pier Elev. 1139.42
Pile cut off Elev. 1137.30
EXISTING PIER
Const. Fill placed by Bridge Forces for Demolition of Conc. Arch.
50' long HP10x57
Const. Fill- Brownish sand, clay/silt
℄ Existing Pier Sta. 10+00
SU.1
℄ Intermediate Bent Sta. 10+31.08
SU.2
ELEVATION
Scale : ¼"=1'-0"
Saturated well graded gravel (20% to 25% Loose cobbles)
Hard gray clayey silt
Hard gray pebbly sand silt & clay
SPACING ON ℄ OF CHANNEL
Med. gray silt & clay with gravel seams
Hard bluish gray pebbly sand, silt & clay
BORE HOLE No. 1
17½' East o ℄ Rdwy & 36' N. of N. River Pier
PLAN
Scale : ¼"=1'-0"
℄ Roadway
℄ Brg.
17'-4" Roadway
30'-0"
SHEET LEGEND
1. General Elevation
2. Framing Details
3. Miscellaneous Details
4. Details of Steel Cap & Assembly Details
5 Stringer Layout & Cross Sections
6. Bills of Material

PLATE No. 25(c)





LOCATION PLAN

N.T.S.

REVISIONS		
DATE	BY	DESCRIPTION

PROVINCE OF MANITOBA
G. A. De PAUW
REGISTERED ENGINEER
June 29/76

GENERAL ELEVATION

REPAIR TO NORTH APPROACH TO BRIDGE
OVER SOURIS RIVER ON P.R. No. 340
E. OF N.E. ¼ SEC. 5-8-16W. 16'-0" ROADWAY

R.M. OF SOUTH CYPRESS

Province of Manitoba
The Highways Department
Bridge Division

APPROVED BY:

DIRECTOR OF PLANNING — DATE

APPROVED BY
P.Eng. June 29/76
CHIEF BRIDGE ENGINEER — DATE

PROJECT ENGINEER

DESIGN — BY — CHECKED

DETAILS — BY L.M. — TRACED J.C. — CHECKED

SCALE As Shown

SHEET No. 1

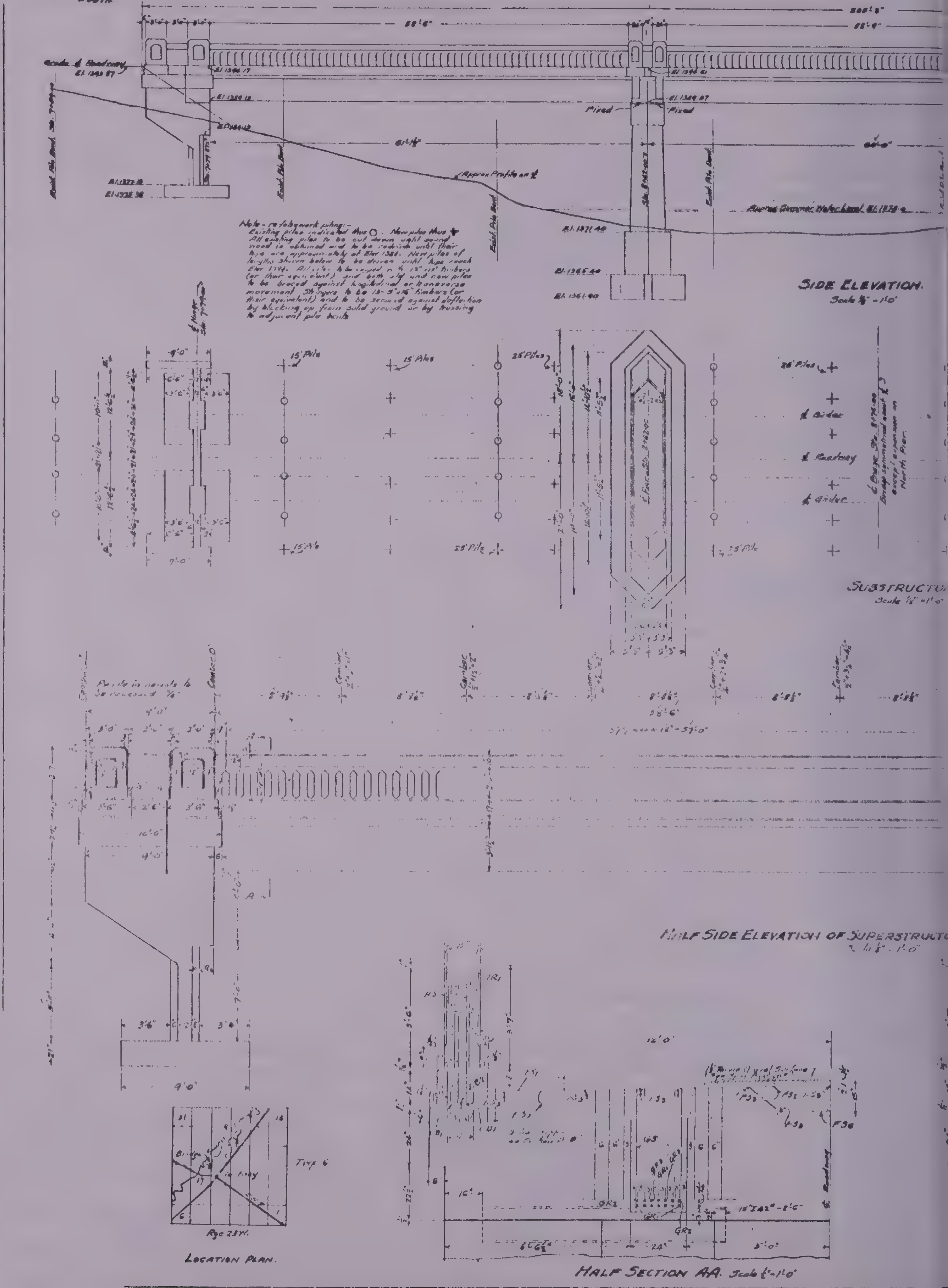
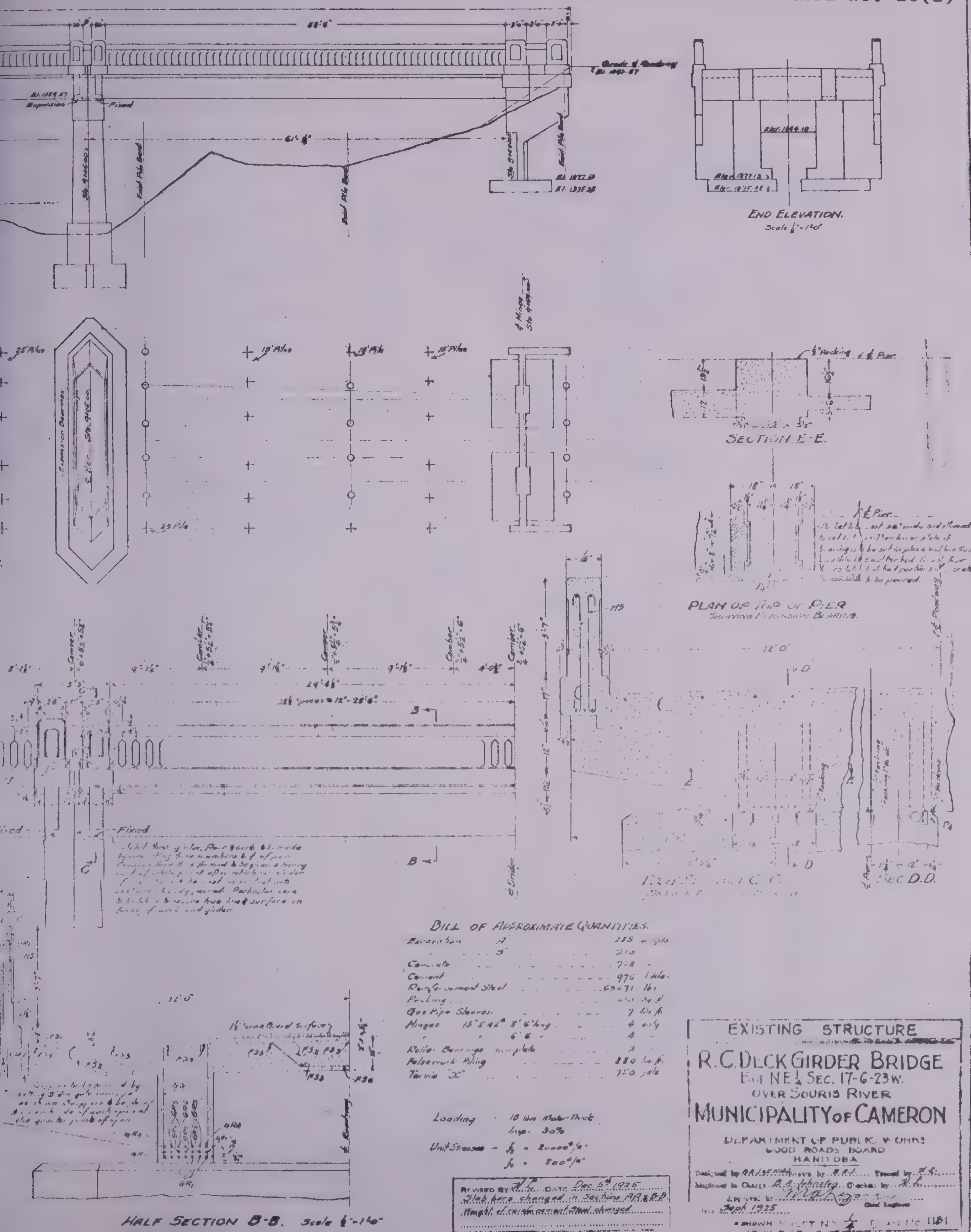

SOUTH
Fixed
Fixed
Approx. Profile on ℄
SIDE ELEVATION.
15' Pile
15' Piles
25' Piles
℄ Girder
℄ Roadway
SUBSTRUCTU
HALF SIDE ELEVATION OF SUPERSTRUCTU
Twp 6
Rge 23 W.
LOCATION PLAN.
HALF SECTION AA.
12'0"

PLATE No. 26(a)



BILL OF APPROXIMATE QUANTITIES.

Excavation A	255	cu. yds
" B	210	"
Concrete	728	"
Cement	976	bbls.
Reinforcement Steel	63871	lbs
Packing	210	sq. ft
Gas Pipe Sleeves.	7	lin. ft
Hinges 15" x 42" 3'6" long	4	only
" " 6'6" "	4	"
Roller Bearings complete	2	"
Falsework Piling	880	lin. ft.
Tarvia "X"	750	gals

Loading · 10 ton Motor Truck
Imp. 30%

Unit Stresses – f_s = 16000#/□"
f_c = 800#/□"

Revised by R.K. Date Dec. 5th 1925
Slab bars changed in Sections AA & B.B.
Weight of reinforcement steel changed.

EXISTING STRUCTURE

R.C. DECK GIRDER BRIDGE
E. of NE ¼ Sec. 17-6-23 W.
OVER SOURIS RIVER
MUNICIPALITY OF CAMERON

DEPARTMENT OF PUBLIC WORKS
GOOD ROADS BOARD
MANITOBA

Designed by R.A.J. & E.N.M. Drawn by R.A.J. Traced by H.C.
Engineer in Charge R.A. Johnston Checked by H.L.
Approved by [signature] Chief Engineer
Date Sept 1925
Shown Sheet No. 4 Plan No. 1181

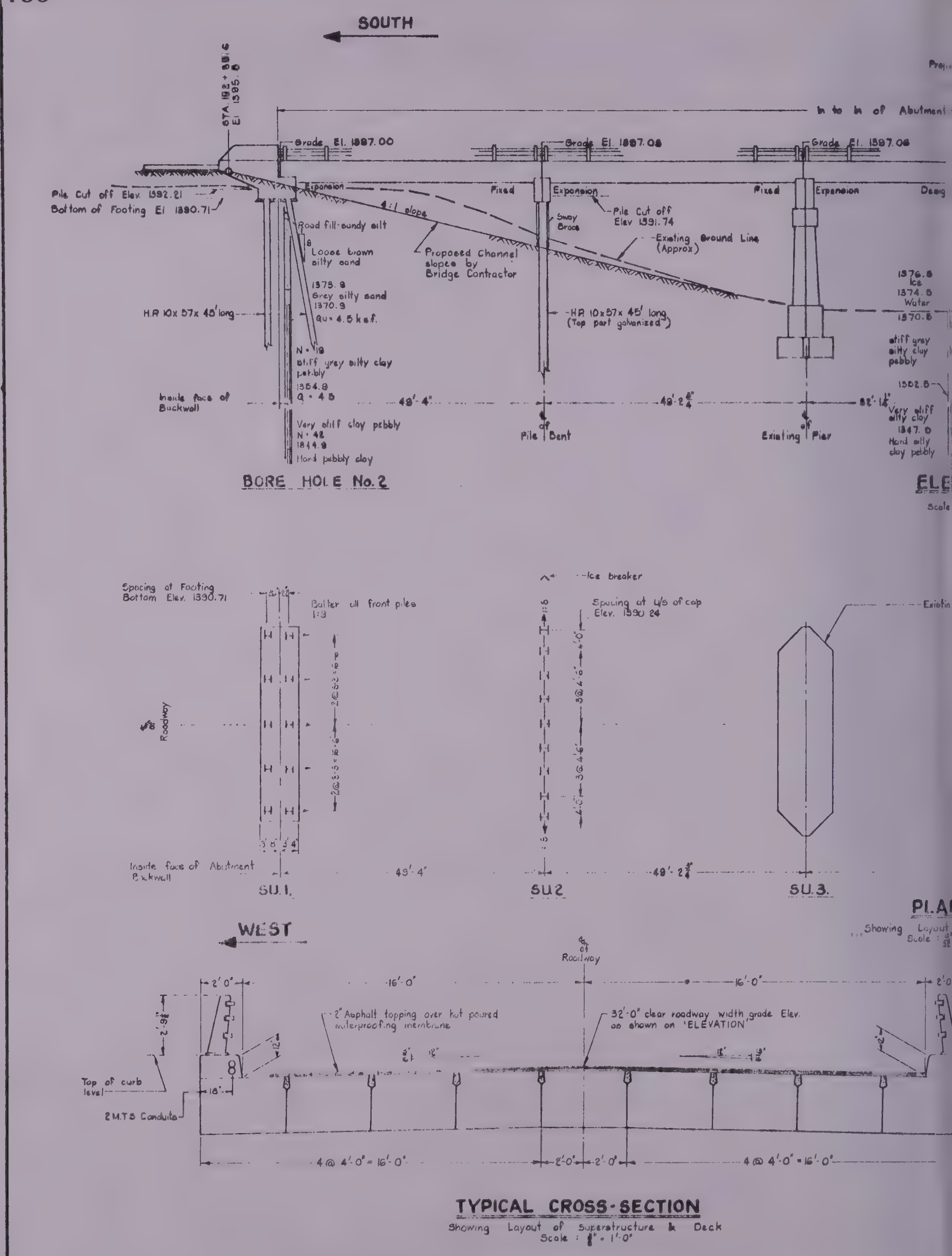
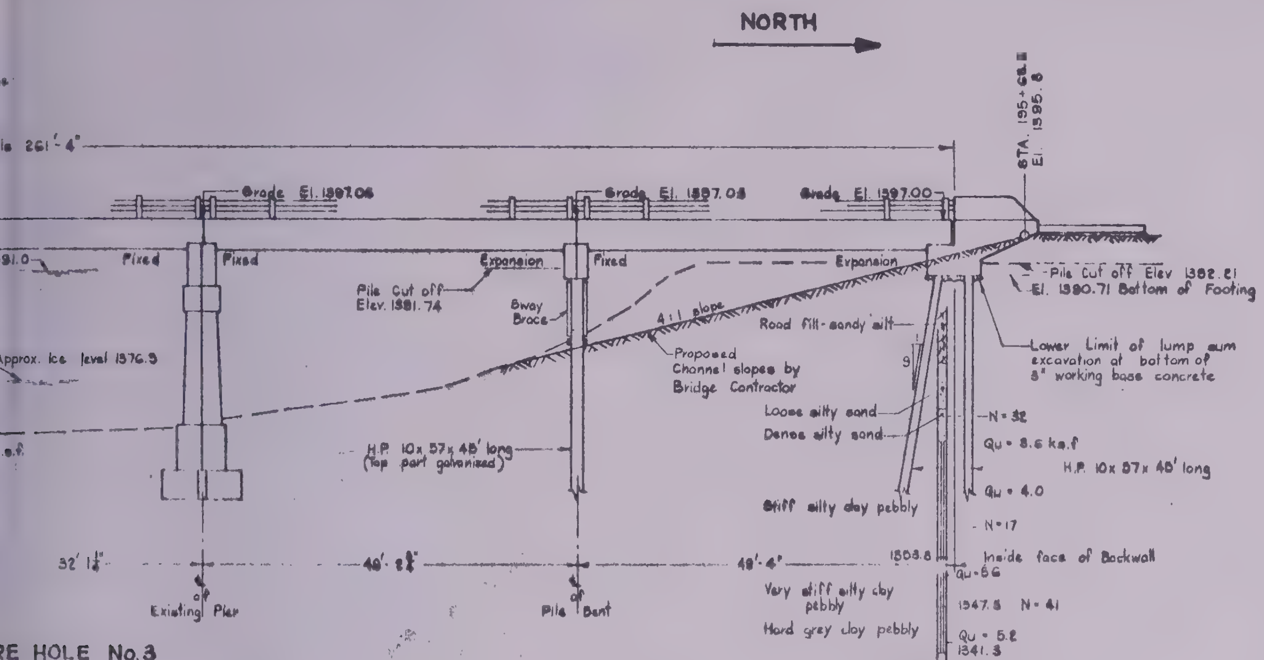

SOUTH
STA. 192 + 88.6
El 1395.8
In to In of Abutment
Grade El. 1387.00
Grade El. 1387.08
Grade El. 1387.06
Expansion
Fixed
Expansion
Fixed
Expansion
Pile Cut off Elev. 1392.21
Bottom of Footing El 1390.71
4:1 slope
Road fill-sandy silt
Loose brown silty sand
Proposed Channel slopes by Bridge Contractor
Sway Brace
Pile Cut off Elev 1391.74
Existing Ground Line (Approx)
1375.9
Grey silty sand
1370.9
qu = 4.5 k.s.f.
H.P. 10x57x 45' long
H.P. 10x57x 45' long (Top part galvanized)
1376.8
Ice
1374.8
Water
1370.8
stiff grey silty clay pebbly
N = 19
stiff grey silty clay pebbly
1354.8
Q = 4.5
Inside face of Backwall
49'-4"
49'-2 3/4"
Very stiff clay pebbly
N = 48
1344.9
Hard pebbly clay
Pile Bent
Existing Pier
Very stiff silty clay
1347.0
Hard silty clay pebbly
BORE HOLE No.2
Spacing at Footing Bottom Elev. 1390.71
Batter all front piles 1:3
Ice breaker
Spacing at U/s of cap Elev. 1390.24
Roadway
Inside face of Abutment Backwall
49'-4'
49'-2 3/4"
SU.1.
SU.2
SU.3.
WEST
of Roadway
2'0"
16'-0"
16'-0"
2" Asphalt topping over hot poured waterproofing membrane
32'-0" clear roadway width grade Elev. as shown on 'ELEVATION'
Top of curb level
18"
2 M.T.S Conduits
4 @ 4'-0" = 16'-0"
2'-0"
2'-0"
4 @ 4'-0" = 16'-0"
TYPICAL CROSS-SECTION
Showing Layout of Superstructure & Deck
Scale : 1/8" = 1'-0"

PLATE No. 26(b)

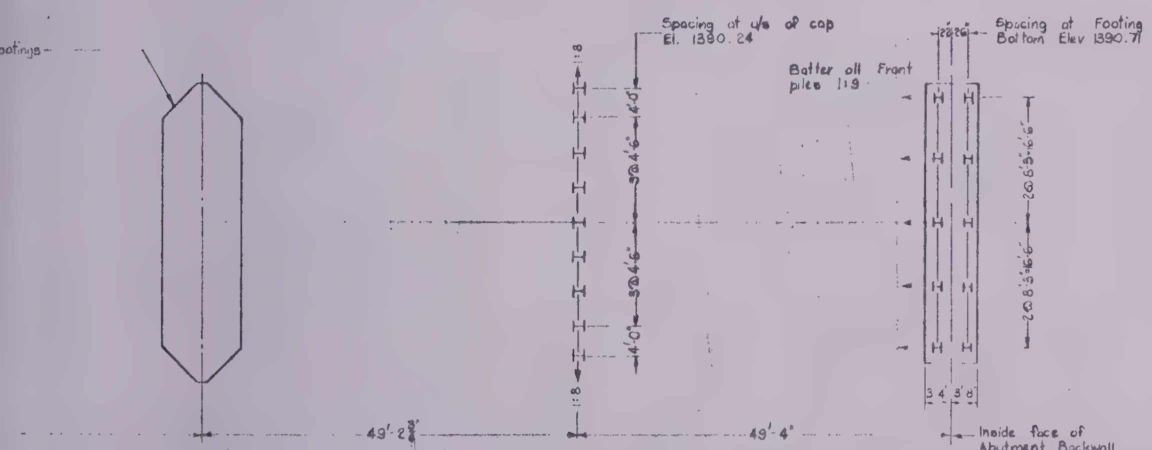


RE HOLE No.3
N

BORE HOLE No.1

NOTE:

1) Foundation Data as shown in Bore Holes is primarily for design purposes & the Department does not guarantee that the information is free from any errors or discrepancies.
2) Limits of excavation for Abutment Footing shall not exceed 2'-0" from all sides of Footing.



SU.4. SU.5. SU.6.

dations

BILL OF PILES			PLAN NO. 1151
NO.	SIZE	LOCATION	Lin Ft.
20	10 H.P. 57 x 45' long	North & South Abutment	900
18	10 H.P. 57 x 45' long	New Intermediate pile Bents (Galvanized for Ed.P.)	810
TOTAL LENGTH LIN. FT			1,710

—Precast Box Girders over long span

Precast Channel Girders over short spans

REVISIONS		
DATE	BY	DESCRIPTION

PROVINCE OF MANITOBA B. SCHOLTZ REGISTERED ENGINEER Oct 12/79

PROVINCE OF MANITOBA M. DACENKO REGISTERED ENGINEER 6/12/79

GENERAL ELEVATION

PROPOSED R.C. BRIDGE 261'- 4" LONG
OVER SOURIS RIVER ON P.T.H. No. 21
E OF N.E. ¼ SEC. 17 - 6 - 23W

R.M. OF CAMERON

Province of Manitoba
The Highways Department
Bridge Division

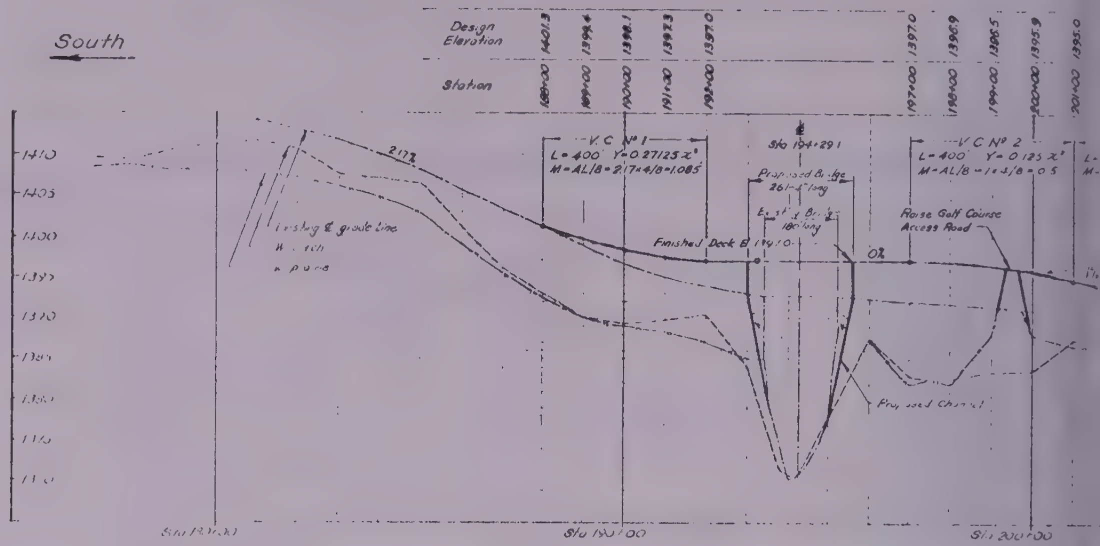
APPROVED BY:
B. Johnston P.Eng. Oct 1979
DIRECTOR OF PLANNING DATE

PROJECT ENGINEER M. DACENKO

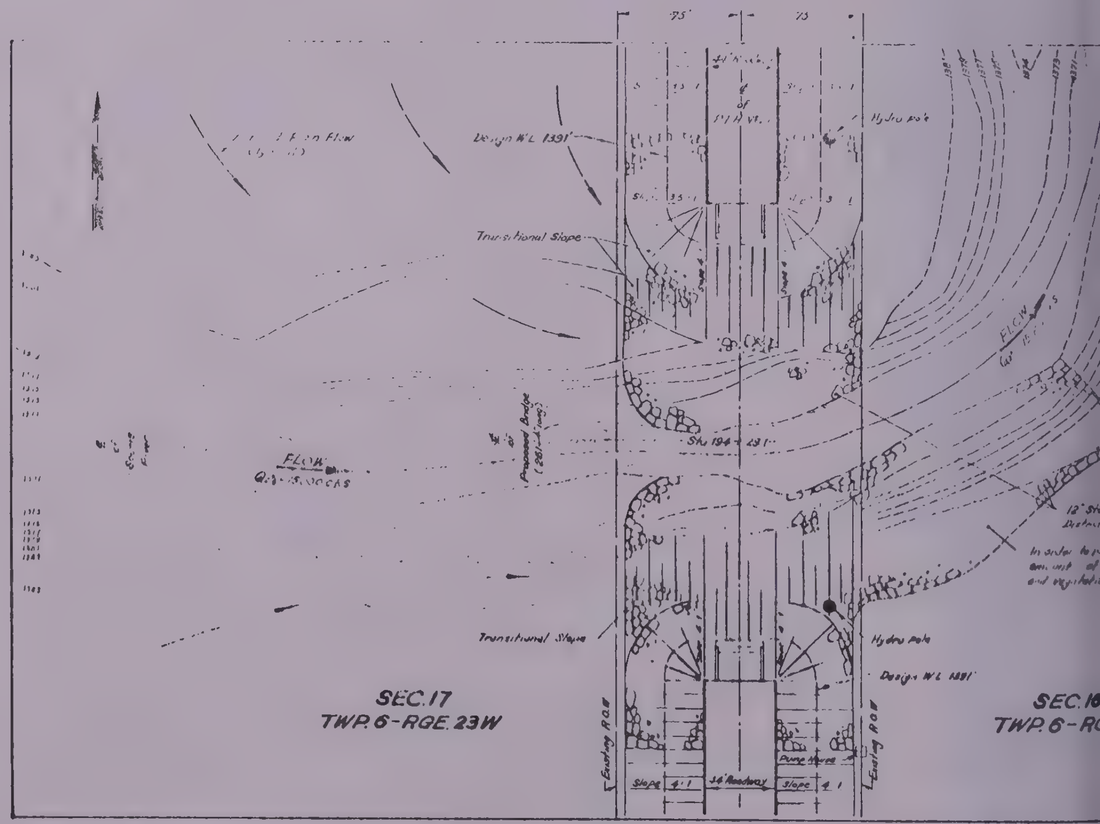
DESIGN	BY	M.D.
	CHECKED	V.R.P.
DETAILS	BY	M.D.
	TRACED	E.F.
	CHECKED	M.D.

APPROVED BY
CHIEF BRIDGE ENGINEER DATE

SCALE as shown
SHEET No. 2
PLAN No. 1151



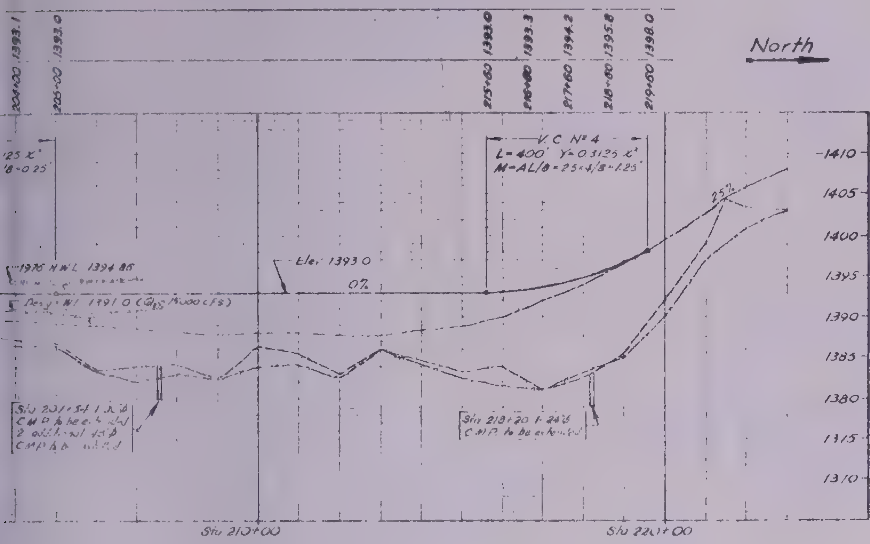
PROFILE

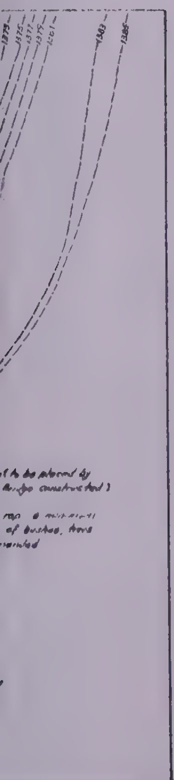


PLAN
Scale: 1" = 50'-0"

Note: See 'General Elevation' Sheet No 2 for Layout of Bridge & Approaches.

PLATE No. 26(c)





B. SCHULTZ
PROVINCE OF MANITOBA
REGISTERED ENGINEER

M. DACENKO
PROVINCE OF MANITOBA
REGISTERED ENGINEER

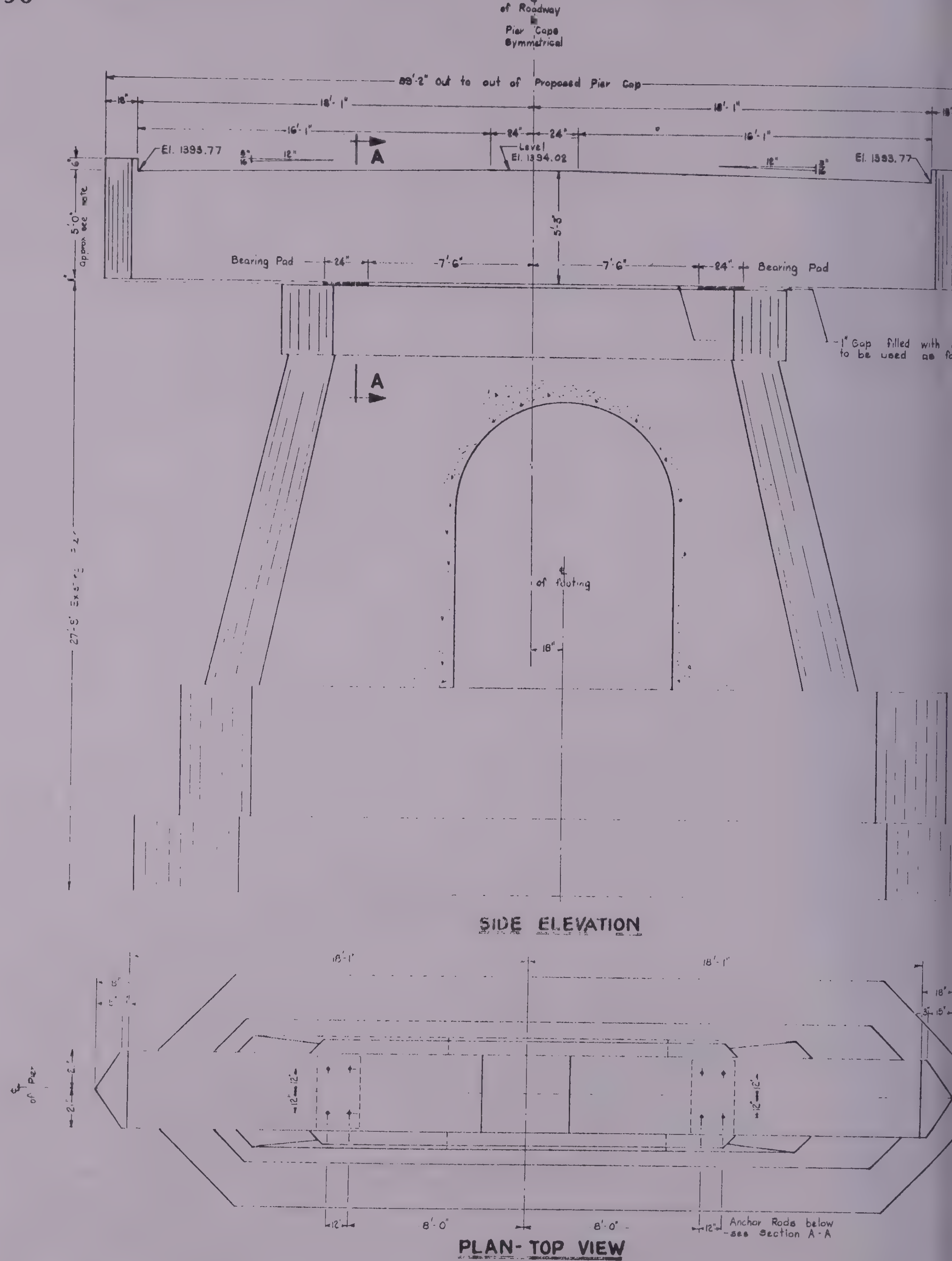
PLAN AND PROFILE

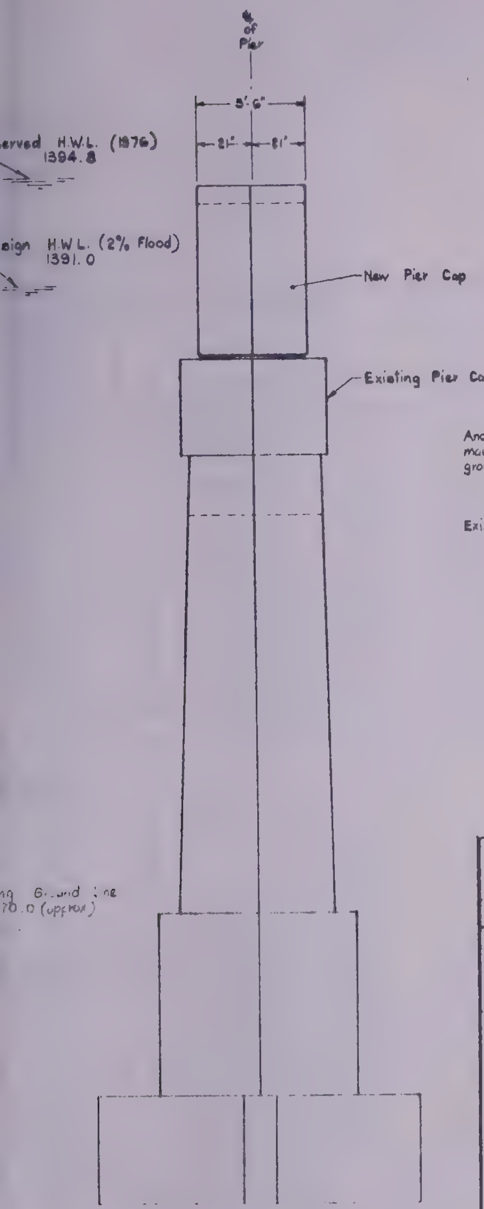
PROPOSED R.C. BRIDGE 261'-4" LONG
OVER SOURIS RIVER ON P.T.H. Nº 21
E. OF N.E. ¼ SEC. 17-TWP. 6-RGE. 23 W

R. M. OF CAMERON

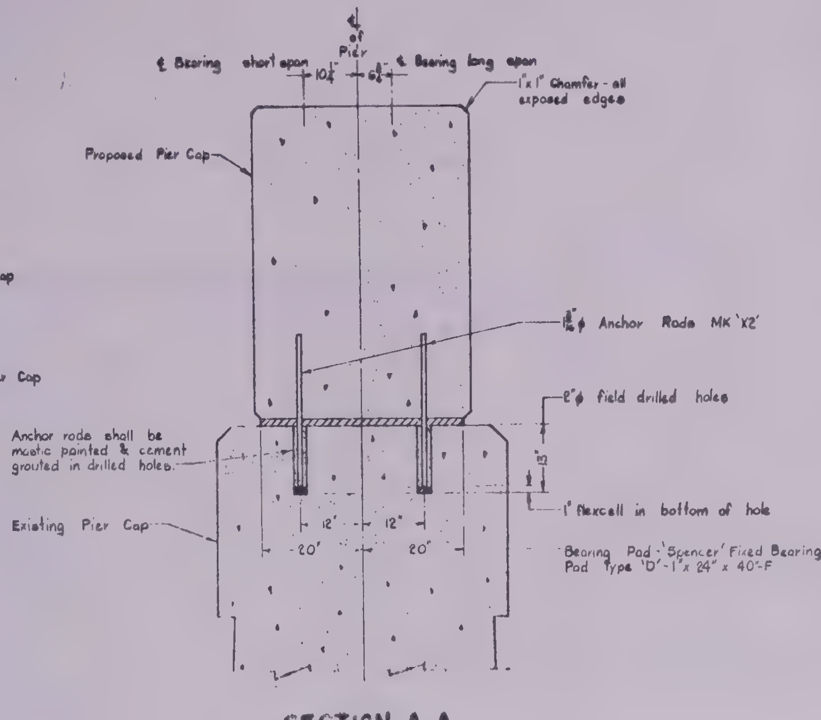
HIGHWAYS DEPARTMENT
CHIEF BRIDGE ENGINEER'S OFFICE
PROVINCE OF MANITOBA

Designed by S.S.S. Drawn by H.L. Traced by H.L.
Design checked by M.D. Drawing checked by M.D.
Approved by [signature] P.Eng. CHIEF BRIDGE ENGINEER — DIRECTOR OF PLANNING
Date May 1979 June 18, 1979 Sheet No. 3
Scale As Shown Plan No. 851


℄ of Roadway & Pier Caps Symmetrical
89'-2" Out to out of Proposed Pier Cap
18" 18'-1" 18'-1"
16'-1" 24" 24" 16'-1"
El. 1393.77
Level El. 1394.02
El. 1393.77
12"
5'-0" approx see note
5'-3"
Bearing Pad 24" 7'-6" 7'-6" 24" Bearing Pad
1" Gap filled with
to be used as
A
A
℄ of footing
18"
27'-5'
SIDE ELEVATION
18'-1" 18'-1"
℄ of Pier
2' 2'
12" 12"
18" 15"
12" 8'-0" 8'-0" 12"
Anchor Rods below -see Section A-A
PLAN-TOP VIEW



END VIEW

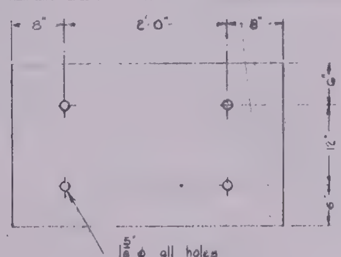


SECTION A-A
Scale ⅜" = 1'0"

BILL OF BEARINGS

PLAN NO 1151

MK	NO.	DESCRIPTION	REMARKS
	4	SPENCER FIXED BEARING PAD TYPE 'D' 1"x 24" x 40"F	see details below



PLAN OF BEARING

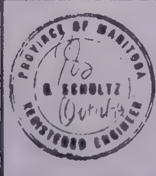
NOTE:
1. 1⅝"ϕ x 2'-6" Anchor Rods MK 'X2' shall be supplied with pier cap reinforcing (See sheet No 8)
2. Adjust pier cap depth to suit req'd Elevation 1394.02

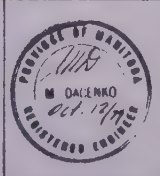
REVISIONS		
DATE	BY	DESCRIPTION

PIER CAPS FOR SU.3. & SU.4.
CONCRETE DETAILS

PROPOSED R.C. BRIDGE 261'-4" LONG
OVER SOURIS RIVER ON P.T.H. No. 21
E. OF N.E. ¼ SEC. 17-6-23W.

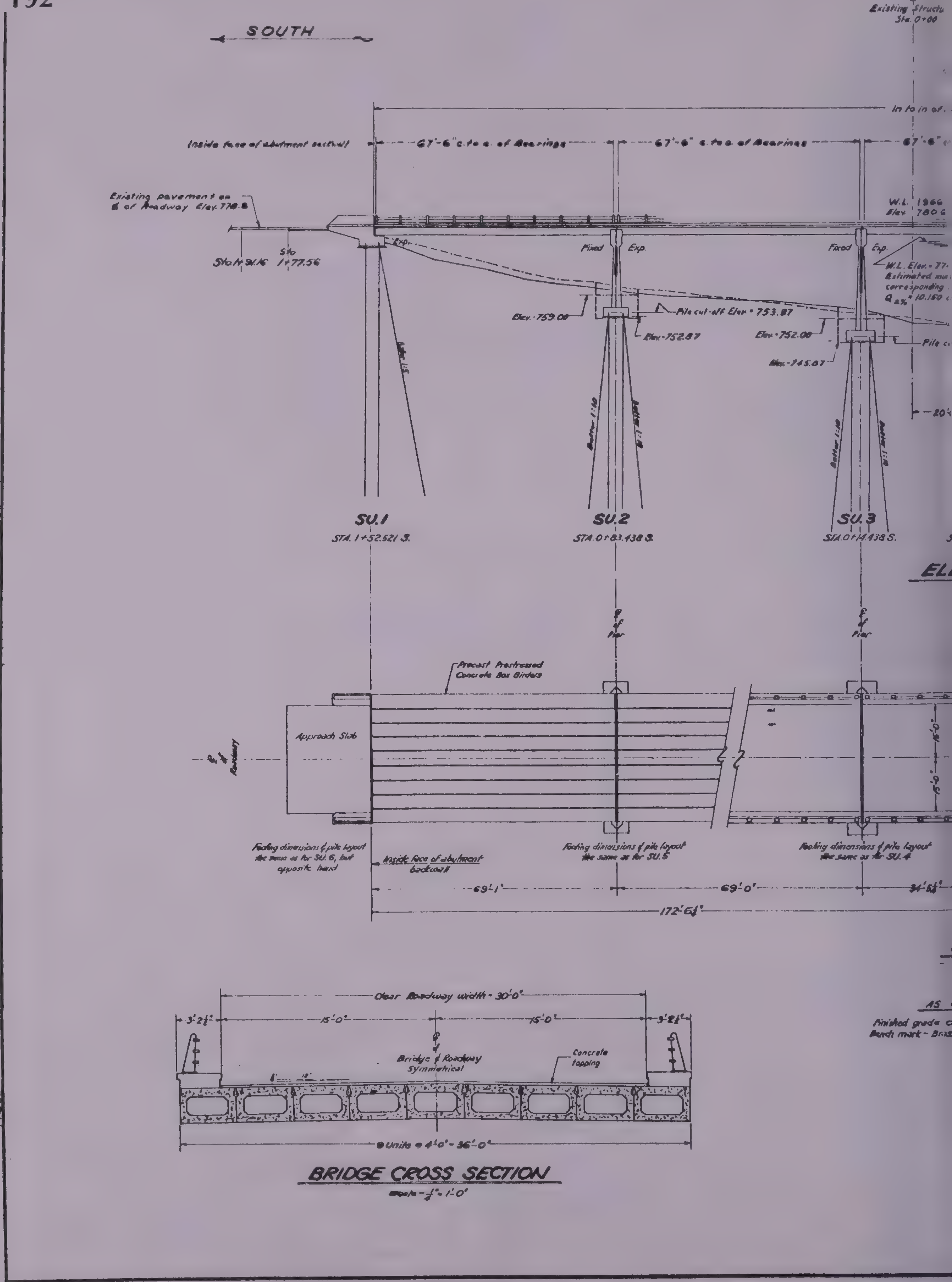
R.M. OF CAMERON





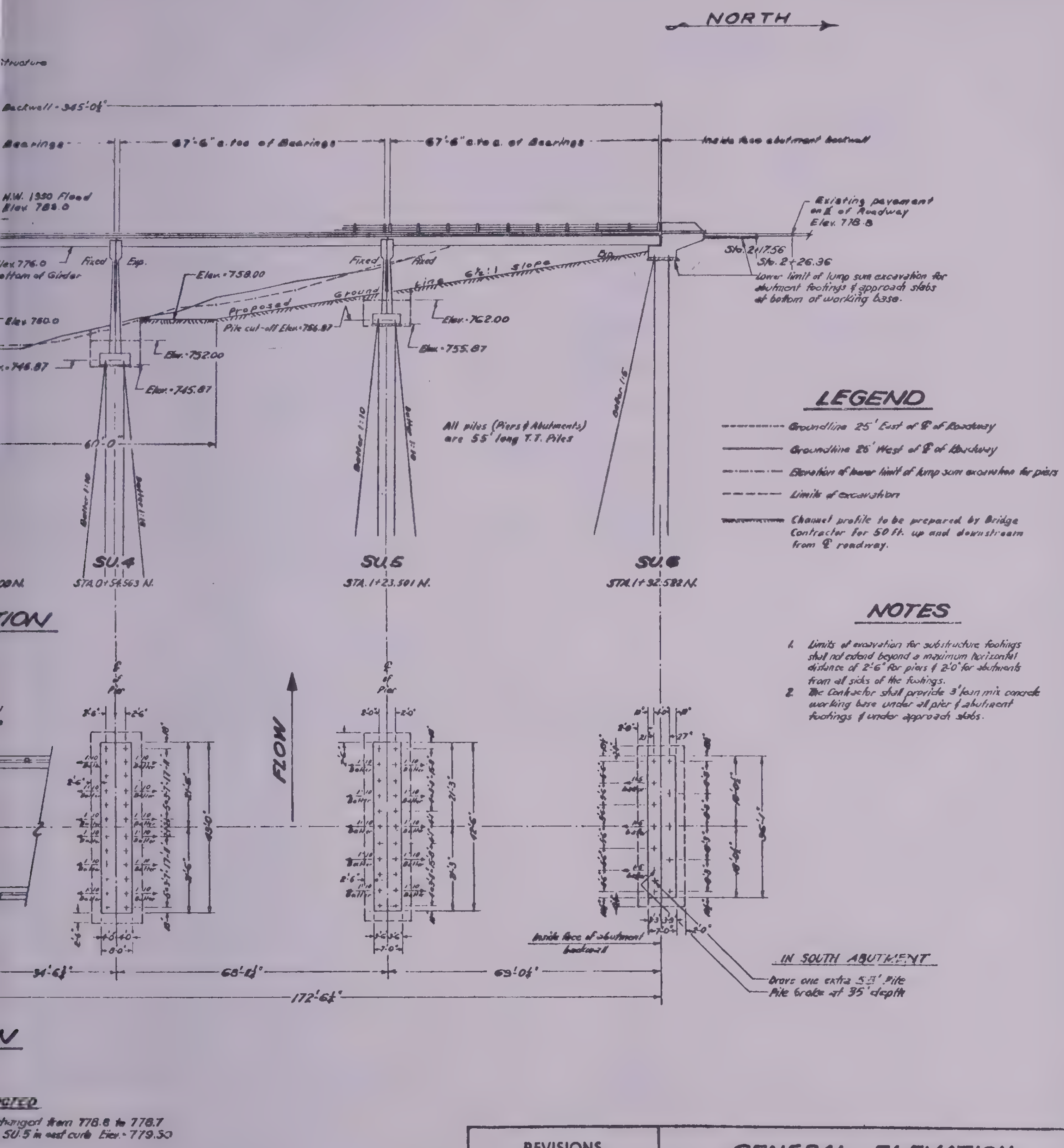
Province of Manitoba
The Highways Department
Bridge Division

PROJECT ENGINEER		M D	APPROVED BY
DESIGN	BY	M D	CHIEF BRIDGE ENGINEER · DATE
	CHECKED	V R P	
DETAILS	BY	M D	SCALE ⅜" = 1'-0" · SHEET No 9
	TRACED	G F	
	CHECKED	M D	or as shown · PLAN No 1151



BRIDGE CROSS SECTION

Scale - ½" = 1'-0"



LEGEND

- Groundline 25' East of ℄ of Roadway
- Groundline 25' West of ℄ of Roadway
- Elevation of lower limit of lump sum excavation for piers
- Limits of excavation
- Channel profile to be prepared by Bridge Contractor for 50 ft. up and downstream from ℄ roadway.

NOTES

1. Limits of excavation for substructure footings shall not extend beyond a maximum horizontal distance of 2'-6" for piers & 2'-0" for abutments from all sides of the footings.
2. The Contractor shall provide 3" lean mix concrete working base under all pier & abutment footings & under approach slabs.

REVISIONS

GENERAL ELEVATION

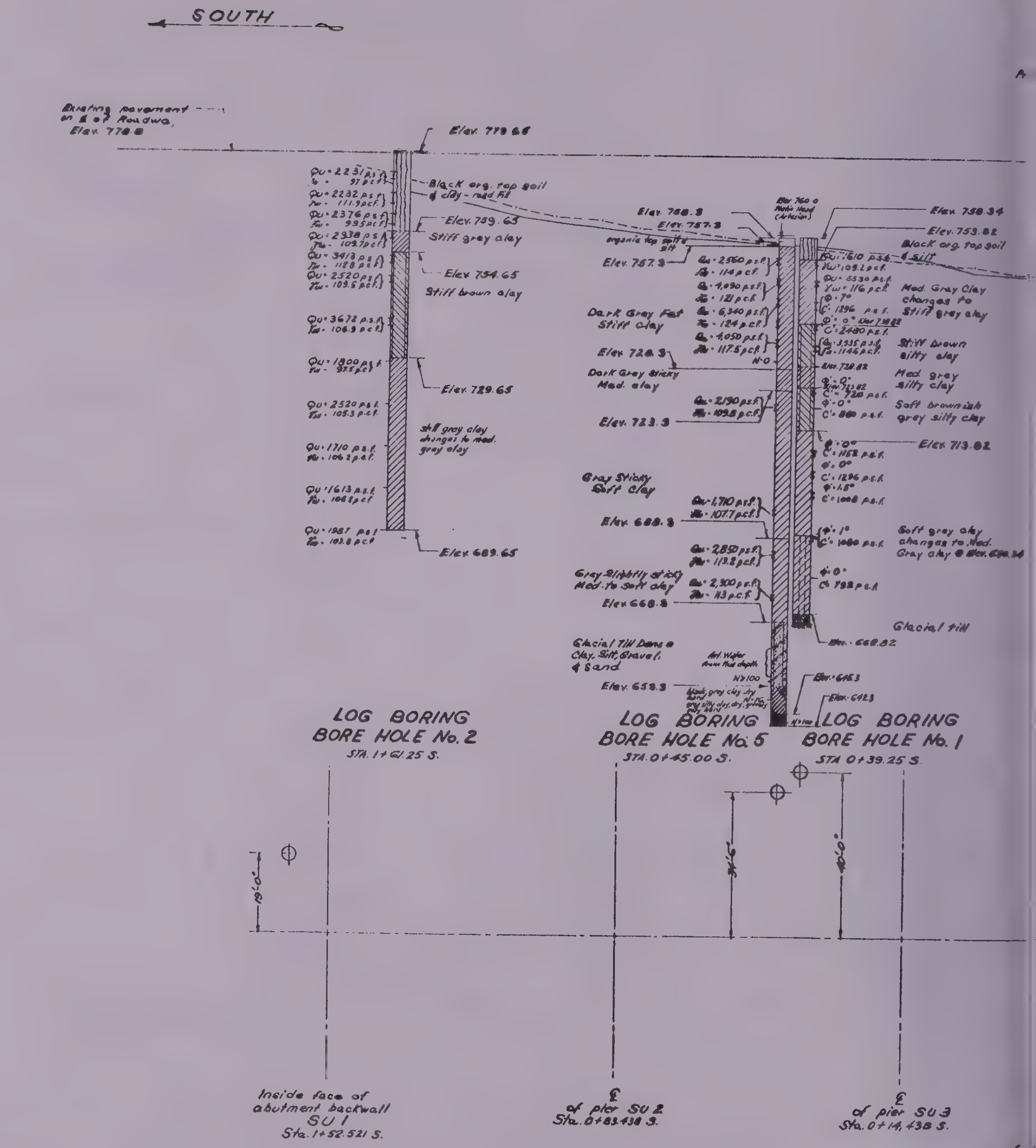
FOR 345'-0½" PRESTRESSED CONCRETE BRIDGE OVER PLUM RIVER ON P.T.H. 75 IN LOT 241 PARISH OF STE. AGATHE

R.M. OF MONTCALM

HIGHWAYS DEPARTMENT
CHIEF BRIDGE ENGINEER'S OFFICE
PROVINCE OF MANITOBA

Designed by: [illegible] Drawn by: W.S.I.T.E. Traced by: W.S.
Design checked by: ______ Drawing checked by: A.M.P.
Approved by: [signature] CHIEF BRIDGE ENGINEER [signature] DIRECTOR OF PLANNING
Date: May 1967 Sheet No. 2/23
Scale: ⅛" - 1'-0" Plan No. 2642

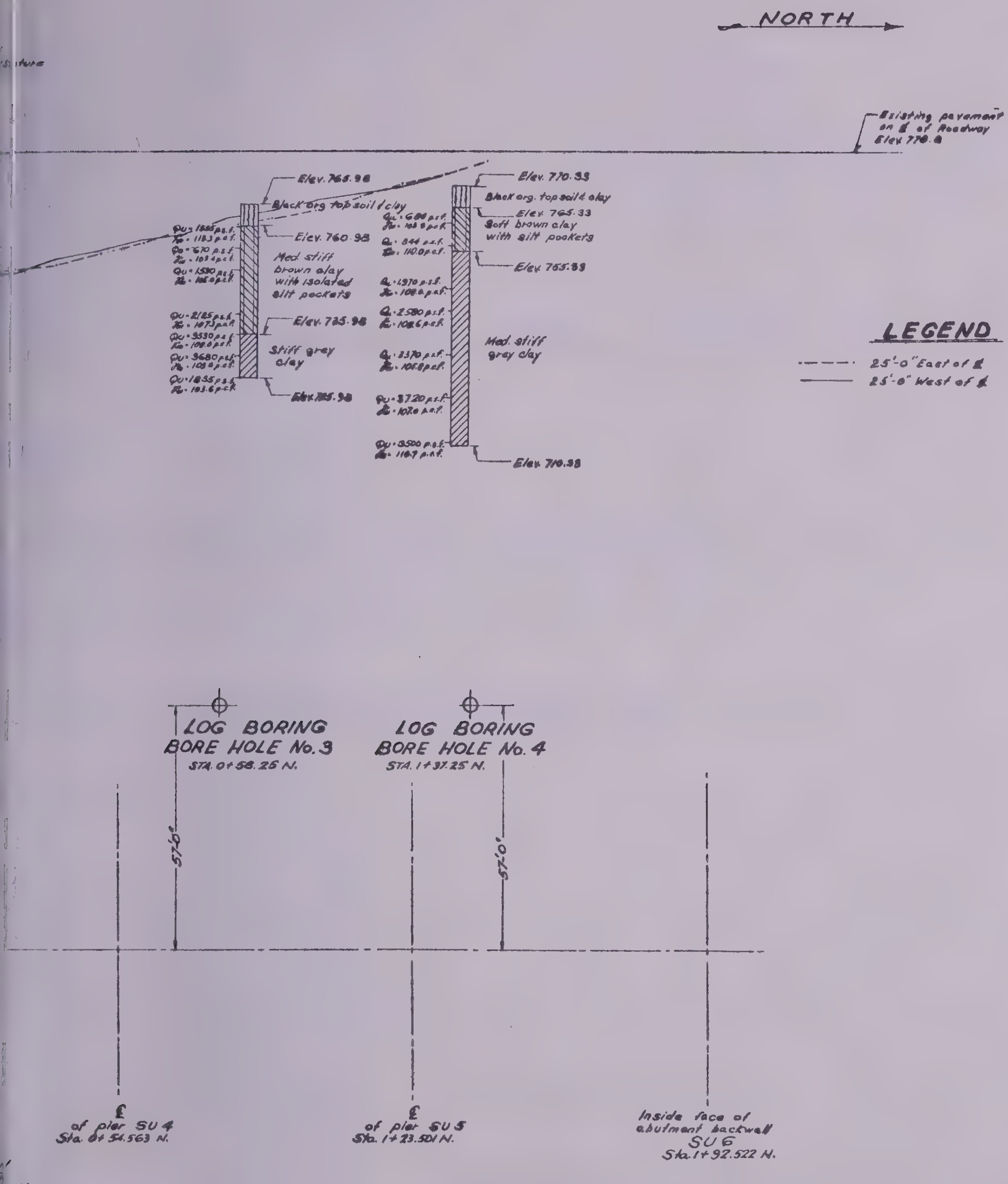
27a



NOTES

a) Foundation data as shown in bore holes is primarily for design purposes, and the Department does not guarantee that the information is free from errors or discrepancies.

PLATE No. 27(b)



REVISIONS

LOG BORING DETAILS

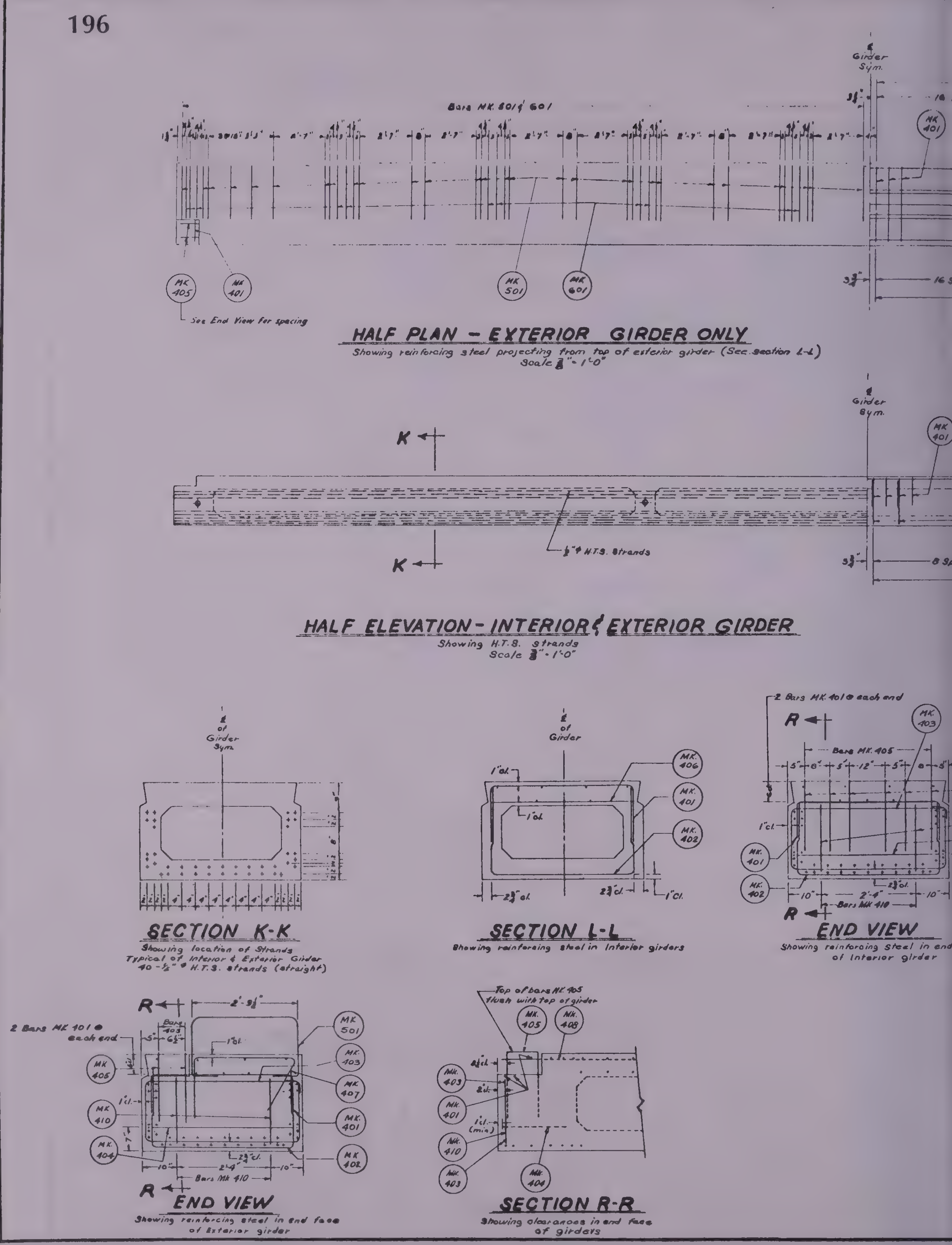
FOR 345'-0½" PRESTRESSED CONCRETE BRIDGE
OVER PLUM RIVER ON P.T.H. 75
IN LOT 241 PARISH OF STE. AGATHE

R.M. OF MONTCALM

HIGHWAYS DEPARTMENT
CHIEF BRIDGE ENGINEER'S OFFICE
PROVINCE OF MANITOBA

Designed by ______ Drawn by W. S. Traced by W. S.
Design checked by ______ Drawing checked by G.M.B.
Approved by [signature] CHIEF BRIDGE ENGINEER ______ DIRECTOR OF PLANNING
Date MAY 1967 Sheet No. 3/29
Scale 1/8" = 1'-0" Plan No. 2542

?761



HALF PLAN - EXTERIOR GIRDER ONLY
Showing reinforcing steel projecting from top of exterior girder (See section L-L)
Scale 3/8" = 1'-0"

HALF ELEVATION - INTERIOR & EXTERIOR GIRDER
Showing H.T.S. strands
Scale 3/8" = 1'-0"

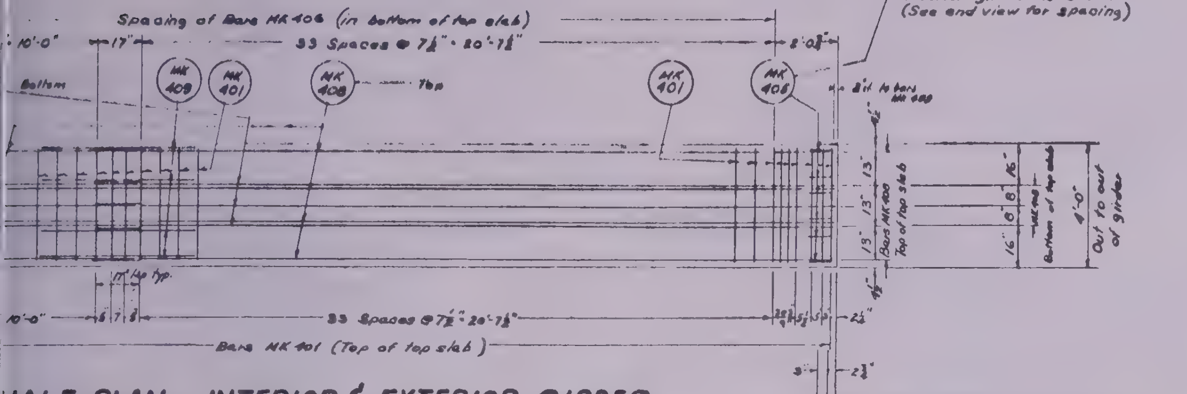
SECTION K-K
Showing location of Strands
Typical of Interior & Exterior Girder
40 - 1/2" ⌀ H.T.S. strands (straight)

SECTION L-L
Showing reinforcing steel in Interior girders

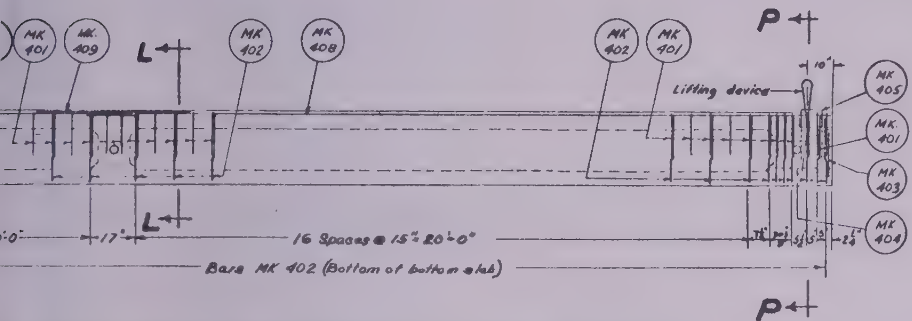
END VIEW
Showing reinforcing steel in end of Interior girder

END VIEW
Showing reinforcing steel in end face of Exterior girder

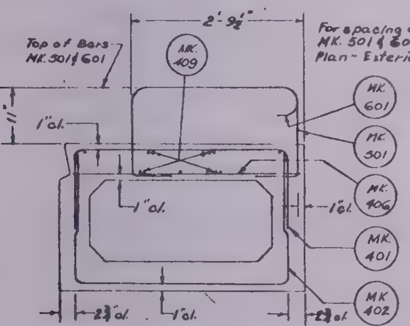
SECTION R-R
Showing clearances in end face of girders



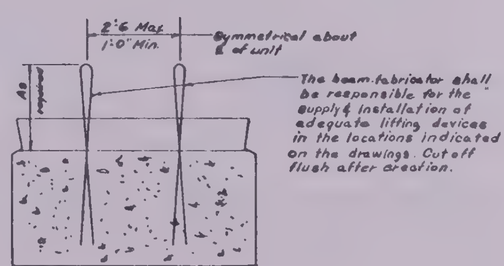
HALF PLAN - INTERIOR & EXTERIOR GIRDER
Showing reinforcing steel in top & bottom of top slab
Scale ⅜" = 1'-0"



F ELEVATION - INTERIOR & EXTERIOR GIRDER
Bars MK.501, 601 & 407 in Exterior girders not shown
Scale ⅜" = 1'-0"



SECTION L-L
Showing reinforcing steel in exterior girders



SECTION P-P
Showing lifting device only

NOTE:
- Construction shall be in accordance with current Highways Department Specifications.
- Clear cover to reinforcing steel 1" Min.
- Initial force in each ½" Φ H.T.S. strand = 25,200 lbs.
- For Bill of Reinforcing Steel see sheet No. 13/23

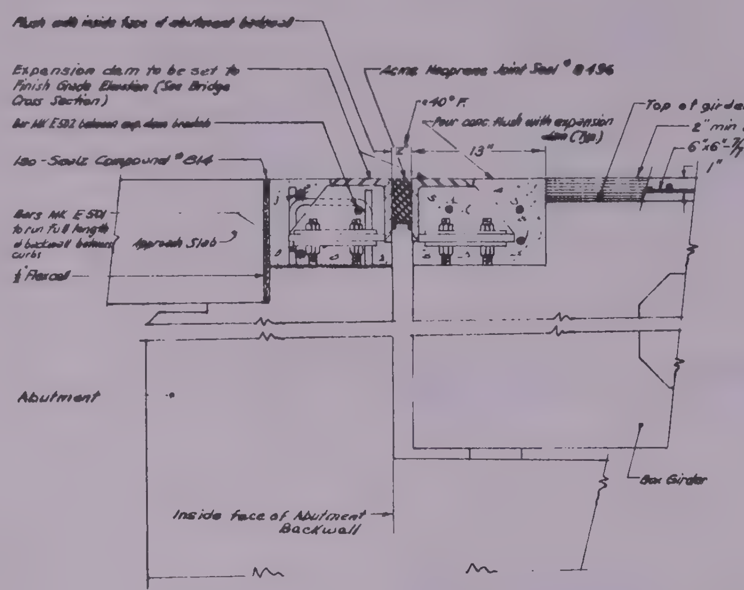
REVISIONS

Longitudinal steel in Top Slab revised to at 408, and 4 - 409's added at splices.
Legs of stirrups 401 changed from 22" to 17".
Legs of stirrups 402 changed from 13" to 24".
October 19/67

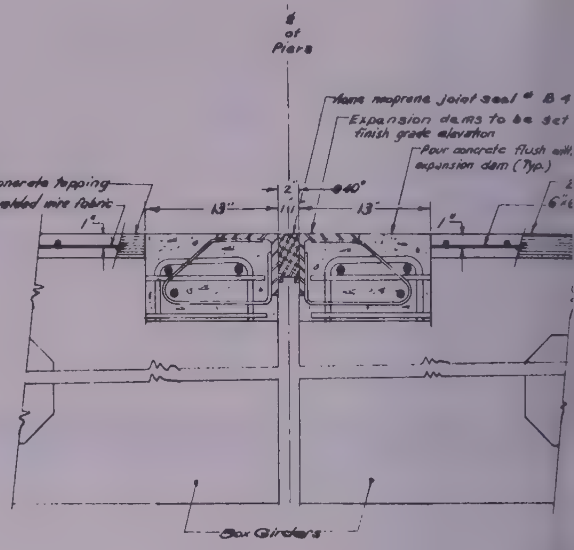
REINFORCING DETAILS
PRECAST PRESTRESSED CONCRETE
BOX GIRDER (PRETENSIONED) 67'-6" SPAN
FOR 345'-0½" PRESTRESSED CONCRETE BRIDGE
OVER PLUM RIVER ON P.T.H. No.75
IN LOT 241 PARISH OF STE. AGATHE
R.M. OF MONTCALM

HIGHWAYS DEPARTMENT
CHIEF BRIDGE ENGINEER'S OFFICE
PROVINCE OF MANITOBA

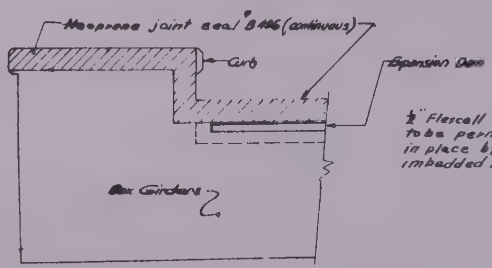
Designed by M.H.T.	Drawn by W.G. Traced by W.G. & T.Z.
Design checked by M.D.	Drawing checked by M.D.
Approved by [signature] CHIEF BRIDGE ENGINEER	DIRECTOR OF PLANNING
Date March 1967	Sheet No. 12/23
Scale ⅜" = 1'-0" or As Shown	Plan No. 2542



DETAIL AT ABUTMENTS

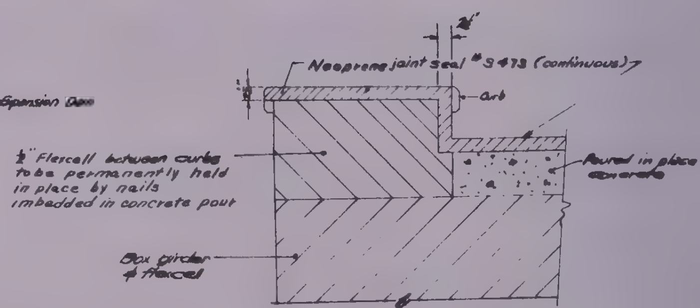


DETAIL AT PIERS SU2,3 & 4



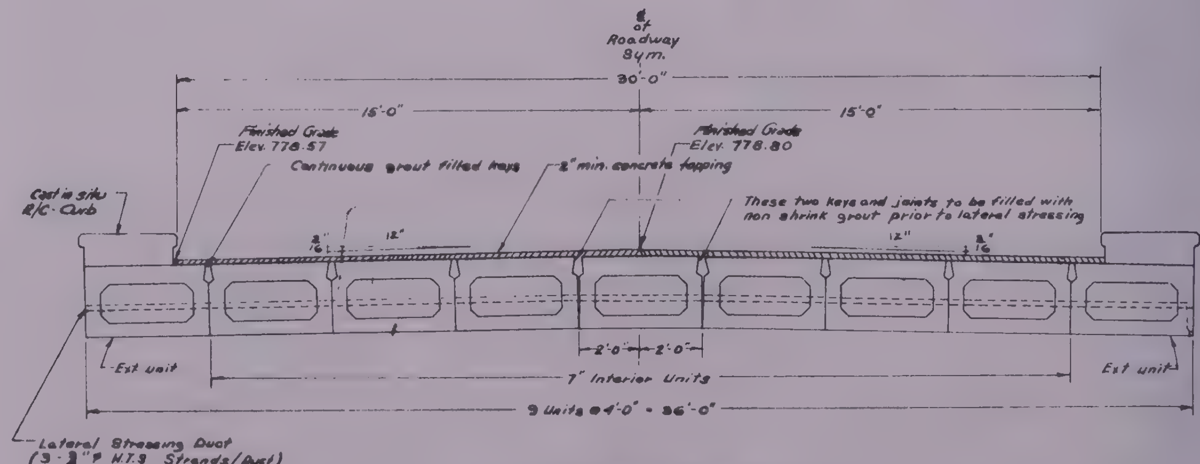
END VIEW AT SU.1, 2, 3, 4 & SU.6

Scale · 1/2"-1'-0"



END VIEW AT PIER SU-5

Scale 1/2"-1'-0"

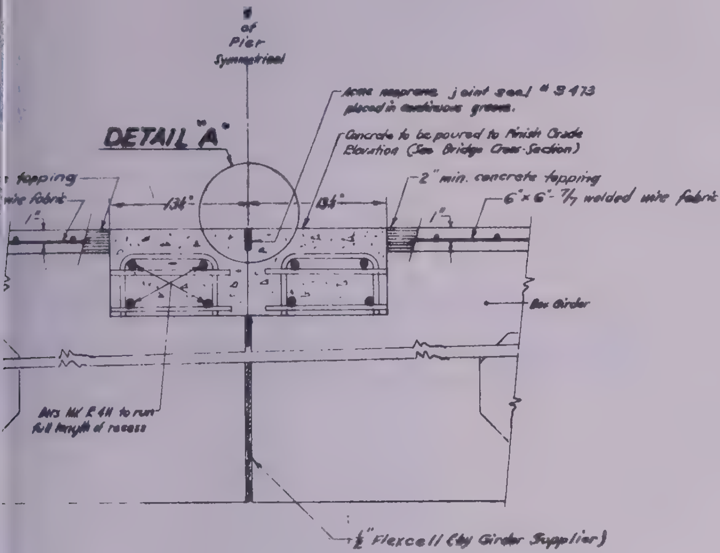


BRIDGE CROSS SECTION

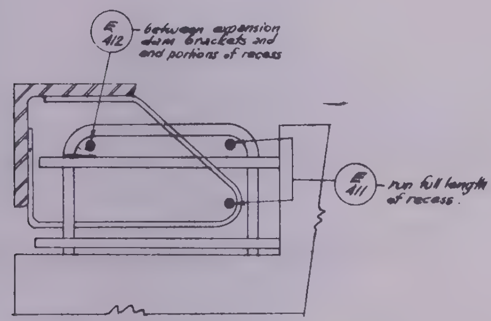
Scale 3/8" = 1'-0"

BILL OF REINFORCING STEEL PLATE No. 27(d)

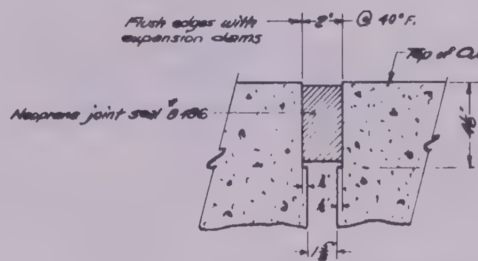
DESCRIPTION	MK & SIZE	NO.	LENGTH	TYPE	WEIGHT
Deformed reinforcing bars	E 411	48	15'-9"	Straight	505
	E 412	64	3'-8"	do	157
	E 501	8	16'-0"	do	134
	E 502	12	3'-8"	do	46
Anchor Rods (plan & galv) 1¼"φ		20	2'-1"	do	174
Total weight of reinforcing steel			-	LBS.	1,016
Volume of concrete in girder recesses			-	Cu. Yds	8.3
Volume of concrete in top of abutment backwalls			-	Cu. Yds	1.6
			TOTAL -	Cu. Yds	9.9



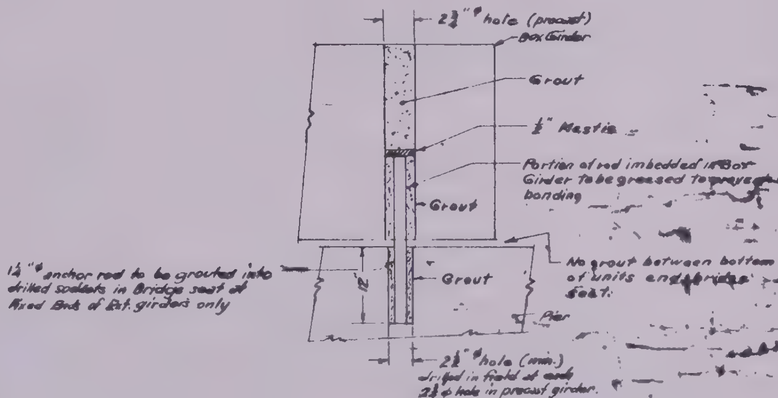
DETAIL AT FIXED PIER SU.-5



CROSS-SECTION
Scale 3"=1'-0"
Showing additional Reinforcing Steel to be cast in concrete girder recesses at SU.1, 2, 3, 4 & SU.6



DETAIL OF CURB
Over SU.1, 2, 3, 4 & SU 6
Scale - 3"=1'-0"



DETAIL
Showing placing of anchor rods
Scale - 1"=1'-0"

DETAIL "A"
Showing concrete dimensions. Similar in tops of curbs
Not to Scale

Sequence of Operations

1. Grouting on each side of centre unit with non-shrink grout
2. Lateral stressing (Initial force in ½"φ strand - 14,000#)
3. Grouting of lateral stressing ducts.
4. Drilling of sockets in Bridge Seats and placing of anchor rods
5. Grouting of keys and anchor rods
6. Placing & setting expansion dams (see note below)
7. Pouring concrete in recesses at girder ends

NOTES:
1. Temperature correction for expansion gap:
   a) Increase gap by 1/16" for every 10°F below +40°F.
   b) Reduce gap by 1/16" for every 10°F above +40°F.
2. Neoprene joint seals shall be installed according to manufacturers specifications

REVISIONS

ASSEMBLY DETAILS

FOR 345'-0½" PRESTRESSED CONCRETE BRIDGE
OVER PLUM RIVER ON P.T.H. No. 75
IN LOT 241 PARISH OF STE. AGATHE

R.M. OF MONTCALM

HIGHWAYS DEPARTMENT
CHIEF BRIDGE ENGINEER'S OFFICE
PROVINCE OF MANITOBA

Designed by M.D.W.S. Drawn by W.S. Traced by W.S.
Design checked by ____ Drawing checked by M.R.
Approved by [signature] CHIEF BRIDGE ENGINEER
Date May 1967 Sheet No 17/23
Scale 1½"=1'-0" or as shown Plan No. 2342

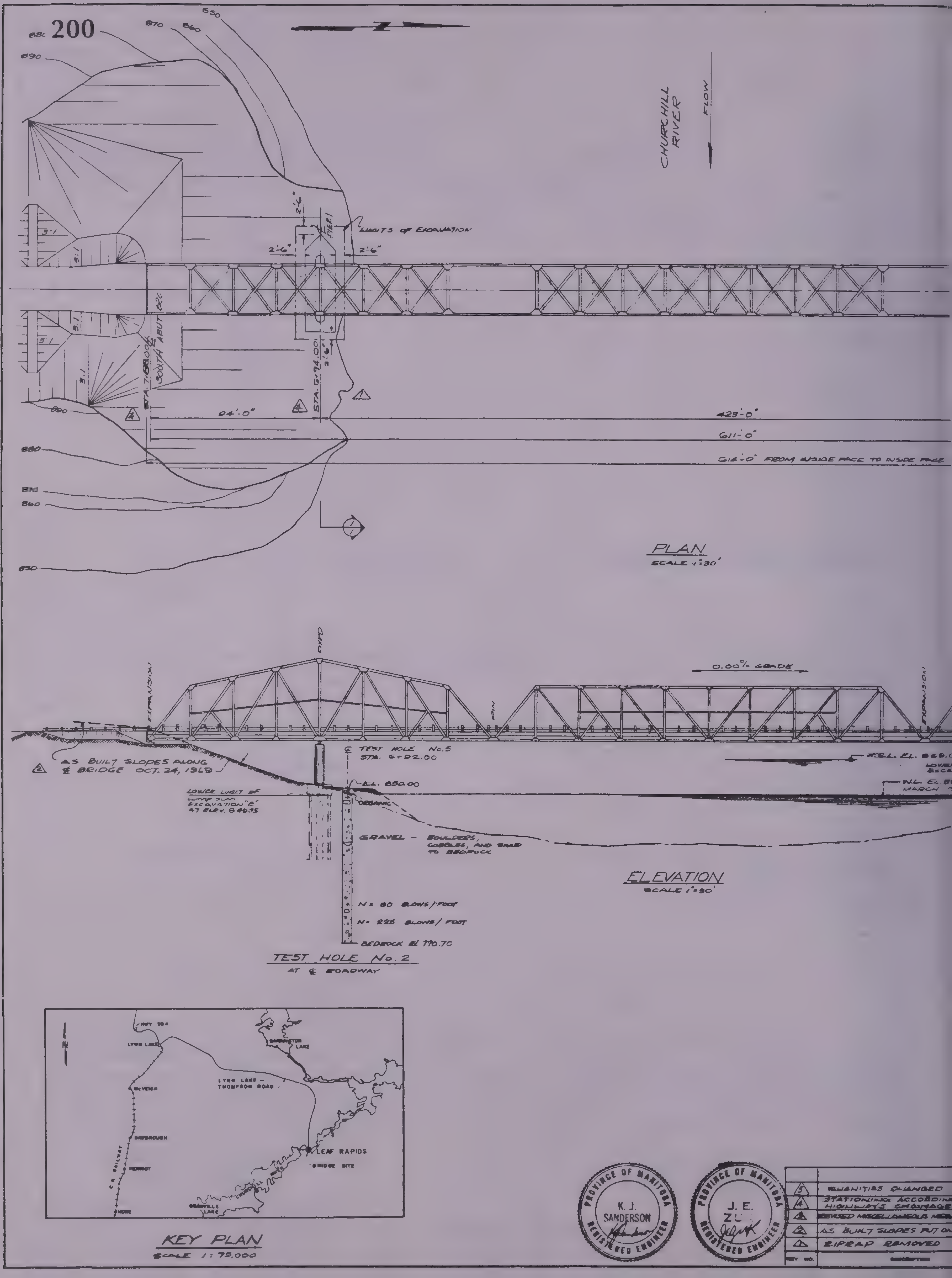
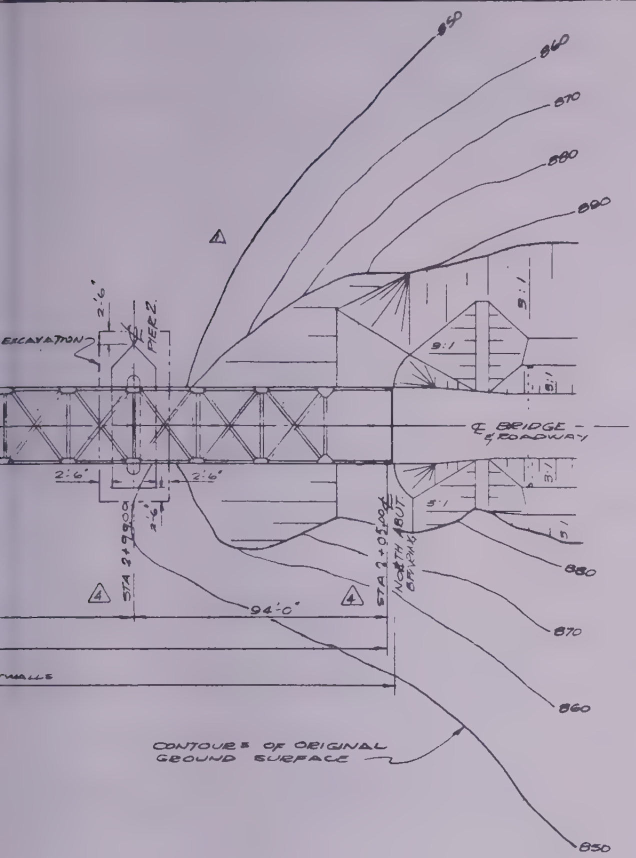
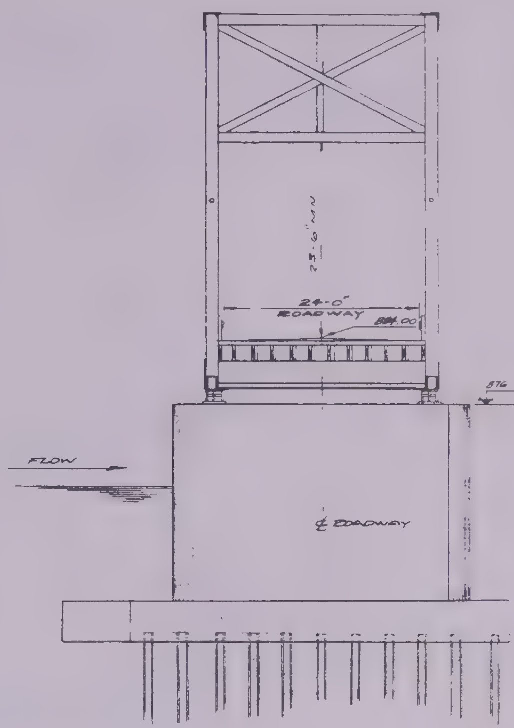

CHURCHILL RIVER
FLOW
LIMITS OF EXCAVATION
PIER 1
2'-6"
STA. 6+94.00
STA. 7+88.00
SOUTH ABUT.
64'-0"
423'-0"
611'-0"
612'-0" FROM INSIDE FACE TO INSIDE FACE
890
880
870
860
850
PLAN
SCALE 1"=30'
0.00% GRADE
EXPANSION
FIXED
PIN
AS BUILT SLOPES ALONG ℄ BRIDGE OCT. 24, 1969
℄ TEST HOLE No.5 STA. 6+92.00
EL. 850.00
LOWER LIMIT OF LUMP SUM EXCAVATION "E" AT ELEV. 849.95
ORGANIC
GRAVEL - BOULDERS, COBBLES, AND SAND TO BEDROCK
N = 80 BLOWS/FOOT
N = 225 BLOWS/FOOT
BEDROCK EL 790.70
TEST HOLE No. 2
AT ℄ ROADWAY
ELEVATION
SCALE 1"=30'
LYNN LAKE
LYNN LAKE - THOMPSON ROAD
LEAF RAPIDS
BRIDGE SITE
C N RAILWAY
KEY PLAN
SCALE 1:75,000
PROVINCE OF MANITOBA
K. J. SANDERSON
REGISTERED ENGINEER
PROVINCE OF MANITOBA
J. E. Z
REGISTERED ENGINEER
QUANTITIES CHANGED
STATIONING ACCORDING HIGHWAYS CHAINAGE
REVISED MISCELLANEOUS
AS BUILT SLOPES PUT ON
RIPRAP REMOVED

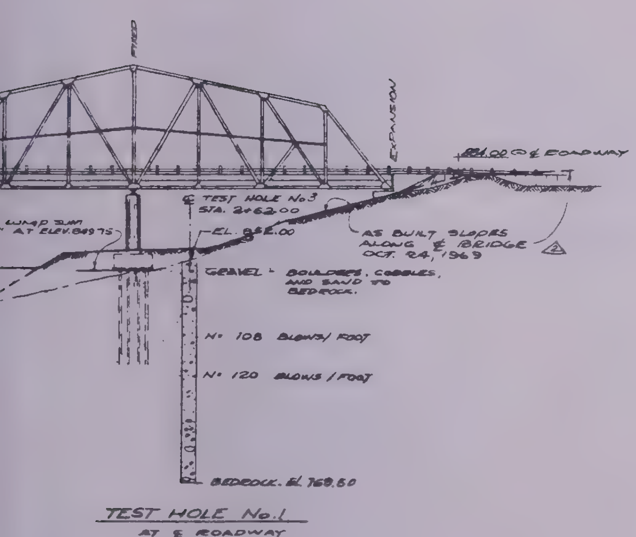
PLATE No. 28(a)





SECTION

SCALE 1"=10'



TEST HOLE No.1

AT € ROADWAY

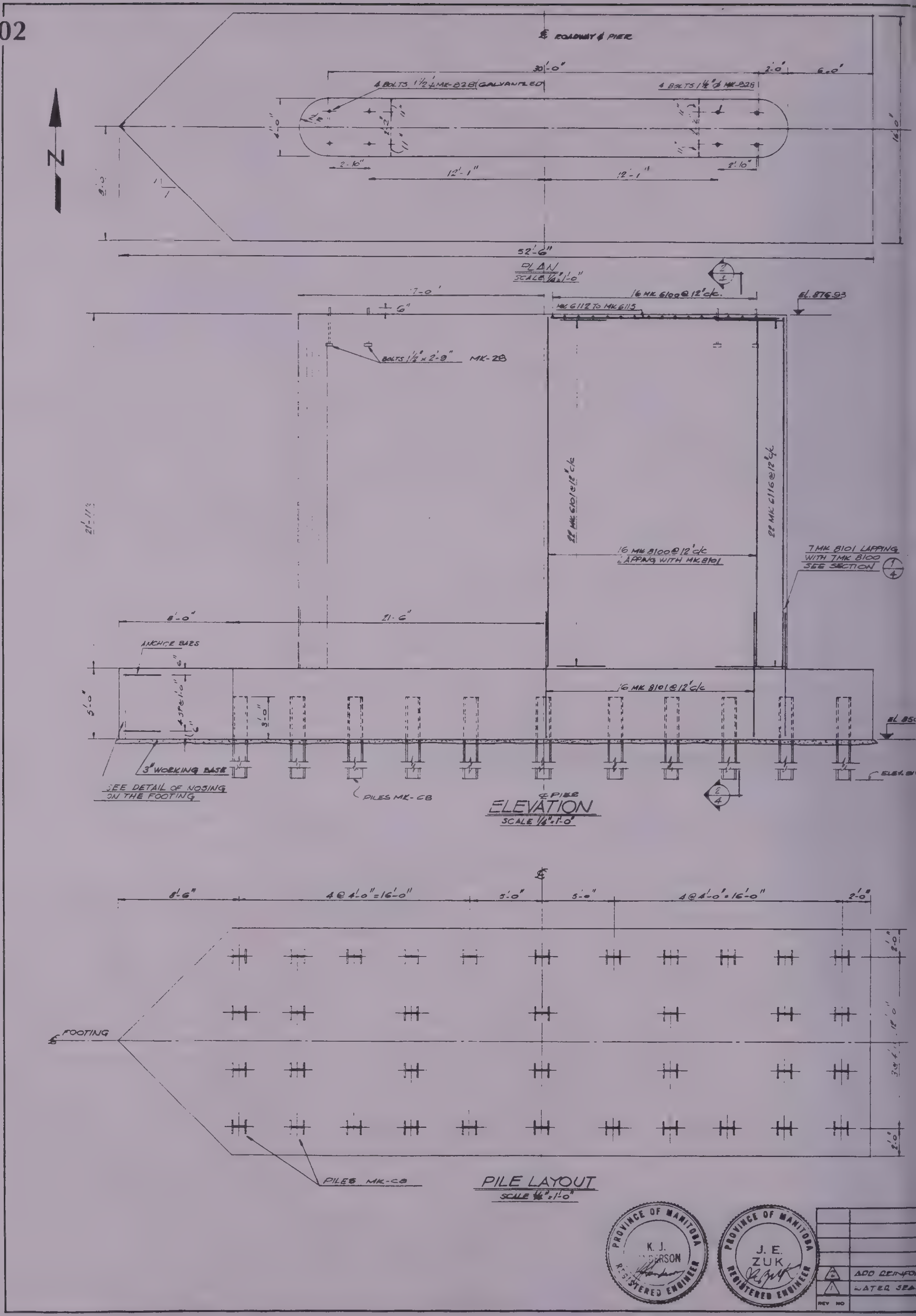
GENERAL NOTES:

1. DESIGN SPECIFICATIONS: - AASHO - 1965
   - CSA S6
   - ACI 318-63
   - AWS D2.0-66
2. DESIGN LOADS: LIVE LOAD: HS 20-44 PLUS IMPACT
3. DESIGN DATA
   (a) STRUCTURAL CONCRETE: f'c = 3000 psi, fc = 1200 psi
   (b) REINFORCING STEEL: INTERMEDIATE GRADE, fy = 40,000 psi, fs = 20,000 psi
   (c) STRUCTURAL STEEL:
   i) ASTM A36 — fy = 36000 psi, fs = 20,000 psi
   ii) CSA G40.8B
   0" to 5/8" — fy = 40,000 psi, fs = 22,000 psi
   OVER 5/8" to 1" — fy = 38,000 psi, fs = 21,000 psi
   OVER 1" to 1½" — fy = 36,000 psi, fs = 20,000 psi
   iii) CSA G40.12 to 1½" — fy = 44,000 psi, fs = 24 000 psi
   OVER 1½" TO 2½" — fy = 49,000 psi, fs = 22 000 psi
   iv) ASTM A514 to 2½" — fy = 100 000 psi, fs = 50,000 psi
4. PILE DESIGN LOAD = 150 KIPS
5. REINFORCING STEEL SHALL CONFORM TO ASTM SPECIFICATION: A615-68, GRADE 40
6. NO WELDING OF REINFORCING STEEL SHALL BE DONE WITHOUT THE WRITTEN APPROVAL OF THE ENGINEER.
7. ALL BEARING SEATS ARE TO BE CONSTRUCTED LEVEL.
8. ELEVATIONS SHOWN ARE REFERRED TO GEODETIC DATUM.
9. CONSTRUCTION SPECIFICATIONS - MANITOBA HIGHWAYS DEPARTMENT.
10. THE FOUNDATION SOILS INVESTIGATION DATA IS FOR GENERAL INFORMATION ONLY AND THE CONTRACTOR IS ADVISED THAT THE DEPARTMENT WILL NOT ACCEPT THE RESPONSIBILITY FOR ANY ERRORS OR INACCURACIES CONTAINED THEREIN.

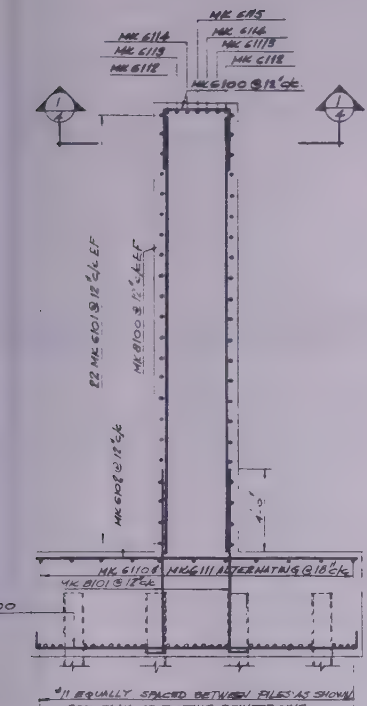
QUANTITIES.

No	DESCRIPTION OF WORK	QUANTITY
1.	GRANULAR BACKFILL	283 cu. yds
2.	LUMP SUM EXCAVATION 'G'	LUMP SUM
3	UNIT EXCAVATION 'E'	475 cu. yds
4	LUMP SUM BACKFILL 'E'	LUMP SUM
5	UNIT BACKFILL 'B'	640 cu. yds
6.	12 BP 102 & BUILT-UP SECTION - 72-40' LG.	2880 LIN. FT
7.	TREATED TIMBER	171,853 BDFT
8	CONCRETE	1144 cu. yds
9	BRIDGE IRON	3449 lb
10.	HEATING CONCRETE	1192 cu. yds
11	REINFORCING STEEL	85,617 lb
12.	STRUCTURAL STEEL	811,652 lbs
13.	MISCELLANEOUS METAL	24,697 lbs
14.	FIELD PAINTING	401 TONS

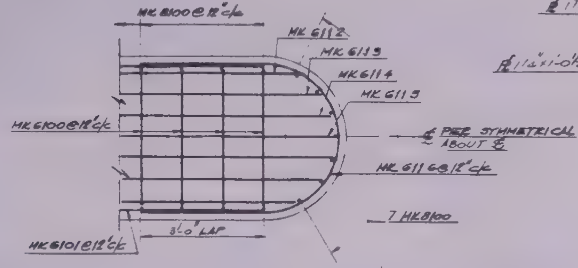
OCT. 70	UNDERWOOD McLELLAN & ASSOCIATES LTD. ENGINEERING & PLANNING CONSULTANTS — BRITISH COLUMBIA . ALBERTA . SASKATCHEWAN . MANITOBA . ONTARIO	PROVINCE OF MANITOBA	GENERAL LAYOUT
OCT. 70	APPROVED BY ___ DATE ___	BRIDGE OVER THE CHURCHILL RIVER SEC 31-86-16W	
OCT. 27/69	DRAWN BY J. E. / DESIGNED BY	APPROVED BY — DATE Aug 6, 1969	PLAN NO 3329 / DRAWING NO. 41-09-313-18 AB / PLATE 1 / REV
OCT. 27/69	CHECKED BY K. J. S. / CHECKED BY	CHIEF BRIDGE ENGINEER / DIRECTOR OF PLANNING	SCALE AS SHOWN
DATE			



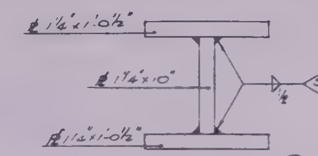
℄ ROADWAY & PIER
30'-0"
2'-0"
6'-0"
4 BOLTS 1½" Ø MK-B28 (GALVANIZED)
4 BOLTS 1½" Ø MK-B28
4'-0"
16'-0"
2'-10"
12'-1"
12'-1"
2'-10"
52'-6"
PLAN
SCALE ⅛"=1'-0"
17-0'
16 MK 6100 @ 12" c/c.
MK 6112 TO MK 6115
EL. 876.93
BOLTS 1½" x 2'-9" MK-28
22 MK 6101 @ 12" c/c
22 MK 6116 @ 12" c/c
16 MK 8100 @ 12" c/c
LAPPING WITH MK 8101
7 MK 8101 LAPPING
WITH 7 MK 8100
SEE SECTION
8'-0"
21'-6"
ANCHOR BARS
5'-0"
16 MK 8101 @ 12" c/c
3" WORKING BASE
SEE DETAIL OF NOSING
ON THE FOOTING
PILES MK-C8
℄ PIER
ELEVATION
SCALE ⅛"=1'-0"
8'-6"
4 @ 4'-0" = 16'-0"
5'-0"
5'-0"
4 @ 4'-0" = 16'-0"
2'-0"
℄ FOOTING
PILES MK-C8
PILE LAYOUT
SCALE ⅛"=1'-0"
PROVINCE OF MANITOBA
K. J.
REGISTERED ENGINEER
PROVINCE OF MANITOBA
J. E.
ZUK
REGISTERED ENGINEER
ADD REINFO
WATER SEA
REV NO



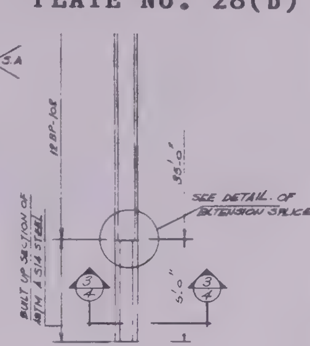
SECTION 2/4
SCALE 1/4" = 1'-0"



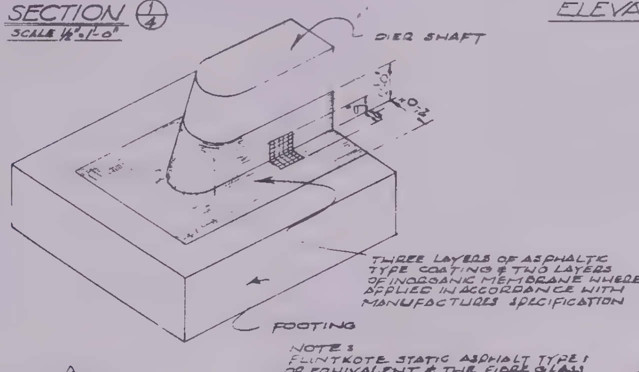
SECTION 1/4
SCALE 1/2" = 1'-0"



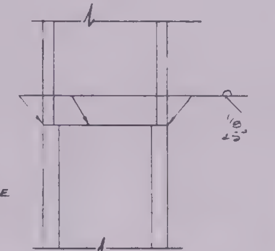
SECTION 3/4
SCALE 1½" = 1'-0"



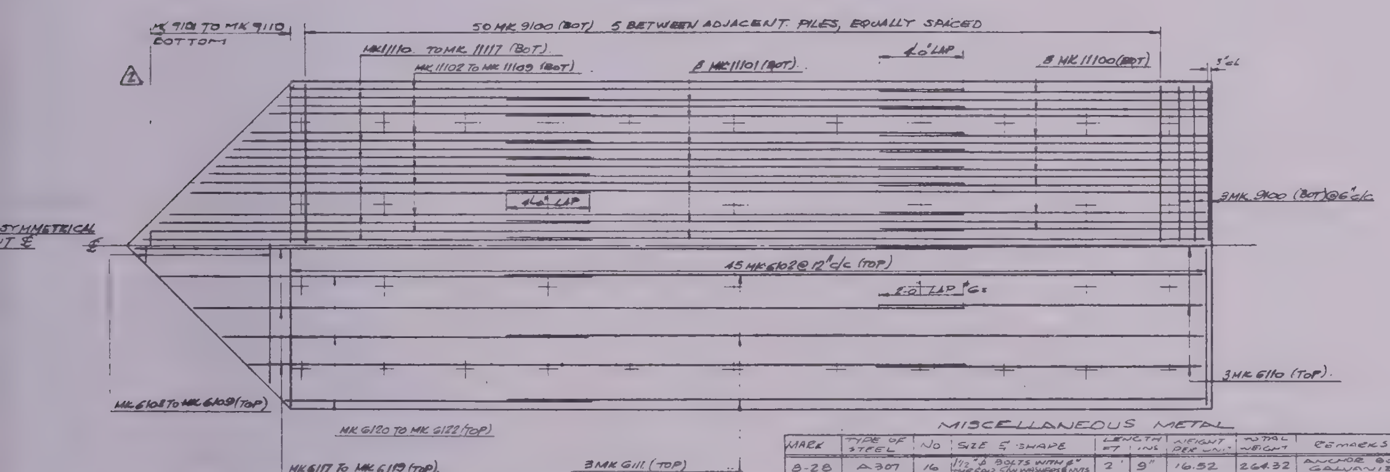
ELEVATION OF PILE MK-C8
N.T.S.



DETAIL OF WATER SEAL AROUND BASE OF PIER



DETAIL OF EXTENSION SPLICE
SCALE 1½" = 1'-0"



PLAN OF FOOTING REINFORCING
SCALE 1/4" = 1'-0"

...TES:
...L EXPOSED EDGES OF PIER CONCRETE
...ALL HAVE A 1½" CHAMFER.
...EAR COVER ON REINFORCING SHALL
... 3" EXCEPT WHERE SHOWN OTHERWISE

MISCELLANEOUS METAL

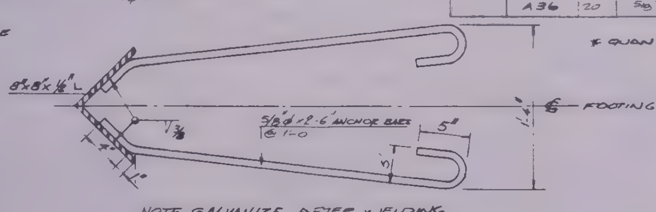
MARK	TYPE OF STEEL	No	SIZE & SHAPE	LENGTH FT	LENGTH INS	WEIGHT PER UNIT	TOTAL WEIGHT	REMARKS
B-28	A307	16	1½" ⌀ BOLTS WITH 6" THREAD C/W WASHERS & NUTS	2'	9"	16.52	264.32	ANCHOR BOLTS GALVANIZED
C-8		76*	12 BP 102 & BUILT-UP SECTION	40'	0"	4424.50	336,262.00	PILES.
C-9	A36	2	8" x 8" x ½" L	5	-	158.40	316.80	PIER NOSING
	A36	20	5/8" ⌀ BAR	2'	6"	2.61	52.20	

TOTAL: 633.32 lbs (EXCLUSIVE OF PILES)

* QUANTITY INCLUDES 4 EXTRA MK C8 STEEL BEARING PILES

QUANTITIES

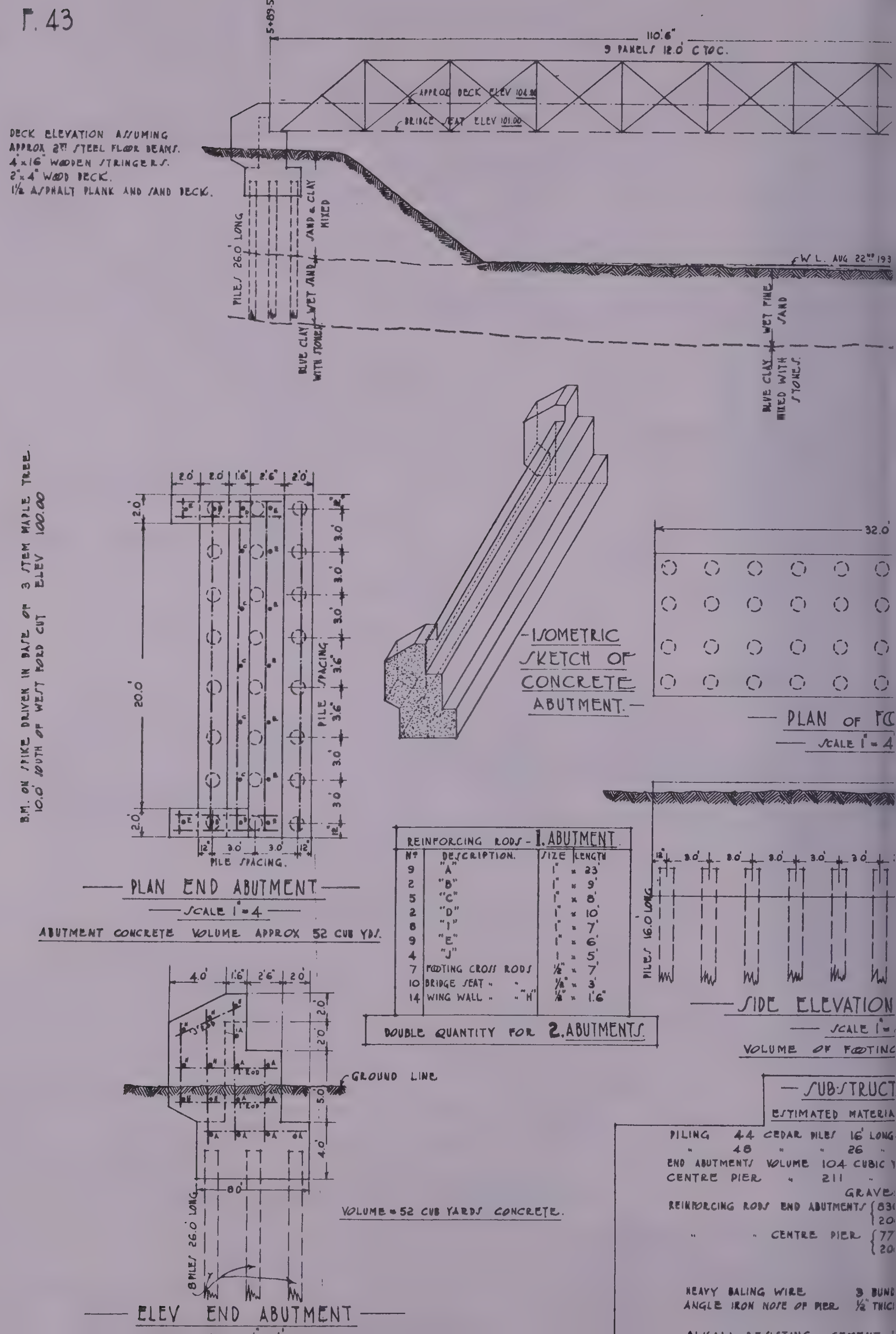
No	DESCRIPTION OF WORK	QUANTITY
1	12 BP 102 & BUILT-UP SECTION 72 - 40'-0" LONG.	2880 LIN.FT.
2	PIER FOOTING CONCRETE	289 CU. YDS
3	PIER SHAFT CONCRETE	216 CU. YDS.
4	REINFORCING STEEL	49,_30 LBS.



NOTE: GALVANIZE AFTER WELDING

DETAIL OF NOSING ON THE FOOTING MK-C9
SCALE 1½" = 1'-0"

...EL TO FOOTING	FEB. 1970	UNDERWOOD McLELLAN & ASSOCIATES LTD. ENGINEERING & PLANNING CONSULTANTS BRITISH COLUMBIA . ALBERTA . SASKATCHEWAN . MANITOBA . ONTARIO	PROVINCE OF MANITOBA	PIERS	
...F PIER	APR. 27/70	APPROVED BY ___ DATE ___	BRIDGE OVER THE CHURCHILL RIVER SEC 31-86-16W		
	DATE	DRAWN BY D R / DESIGNED BY M A / CHECKED BY R Y / CHECKED BY R Y	APPROVED BY ___ DATE Sept. 17, 1969 / CHIEF BRIDGE ENGINEER ___ / DIRECTOR OF PLANNING ___	PLAN NO. 3329 / SCALE AS SHOWN	DRAWING NO. 41-09-313-18 AB / PLATE 5 / REV


5+89.5
110.6"
9 PANELS 12.0 C TO C.
APPROX DECK ELEV 104.90
BRIDGE SEAT ELEV 101.00
DECK ELEVATION ASSUMING
APPROX 8" STEEL FLOOR BEAMS.
4"x16" WOODEN STRINGERS.
2"x4" WOOD DECK.
1½ ASPHALT PLANK AND SAND DECK.
PILES 26.0 LONG
SAND & CLAY MIXED
WET SAND
BLUE CLAY WITH STONES
W L. AUG 22ND 193
WET FINE SAND
BLUE CLAY MIXED WITH STONES.
B.M. ON SPIKE DRIVEN IN BASE OF 3 STEM MAPLE TREE.
10.0 SOUTH OF WEST BORD CUT ELEV 100.00
ISOMETRIC SKETCH OF CONCRETE ABUTMENT.
32.0
PLAN OF FO
SCALE 1" = 4
PILE SPACING
PLAN END ABUTMENT
SCALE 1" = 4
ABUTMENT CONCRETE VOLUME APPROX 52 CUB YDS.
REINFORCING RODS - 1. ABUTMENT
Nº | DESCRIPTION. | SIZE | LENGTH
9 | "A" | 1" x 23'
2 | "B" | 1" x 9'
5 | "C" | 1" x 8'
2 | "D" | 1" x 10'
8 | "I" | 1" x 7'
9 | "E" | 1" x 6'
4 | "J" | 1" x 5'
7 | FOOTING CROSS RODS | ½" x 7'
10 | BRIDGE SEAT " | ⅜" x 3'
14 | WING WALL " "H" | ⅜" x 1.6"
DOUBLE QUANTITY FOR 2. ABUTMENTS.
PILES 16.0 LONG
SIDE ELEVATION
SCALE 1" =
VOLUME OF FOOTING
GROUND LINE
VOLUME = 52 CUB YARDS CONCRETE.
8 PILES 26.0 LONG
ELEV END ABUTMENT
SUBSTRUCT
ESTIMATED MATERIA
PILING 44 CEDAR PILES 16' LONG
" 48 " " 26 "
END ABUTMENTS VOLUME 104 CUBIC Y
CENTRE PIER " 211 "
GRAVE
REINFORCING RODS END ABUTMENTS
" " CENTRE PIER
HEAVY BALING WIRE 3 BUND
ANGLE IRON NOSE OF PIER ½" THICK

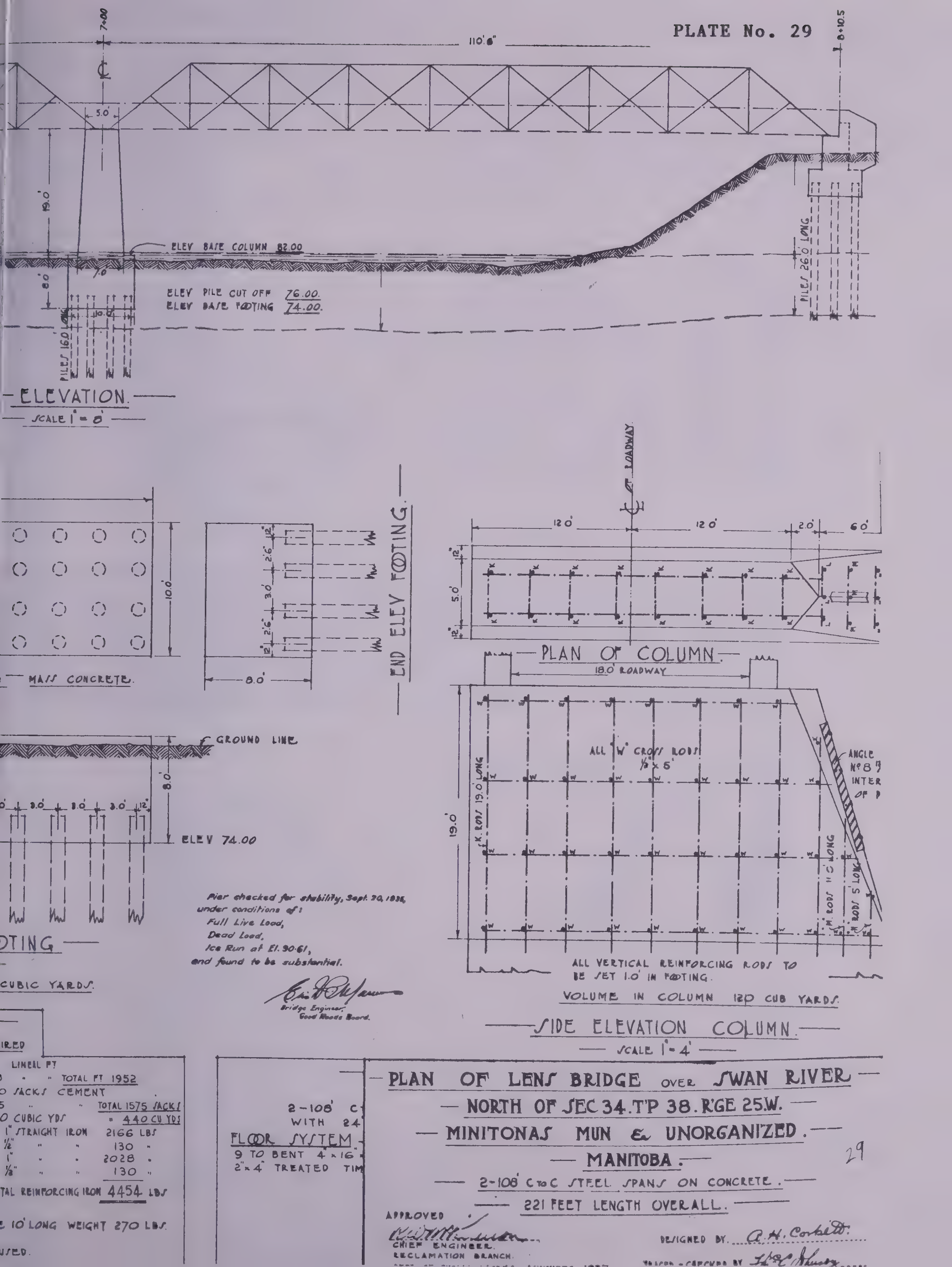
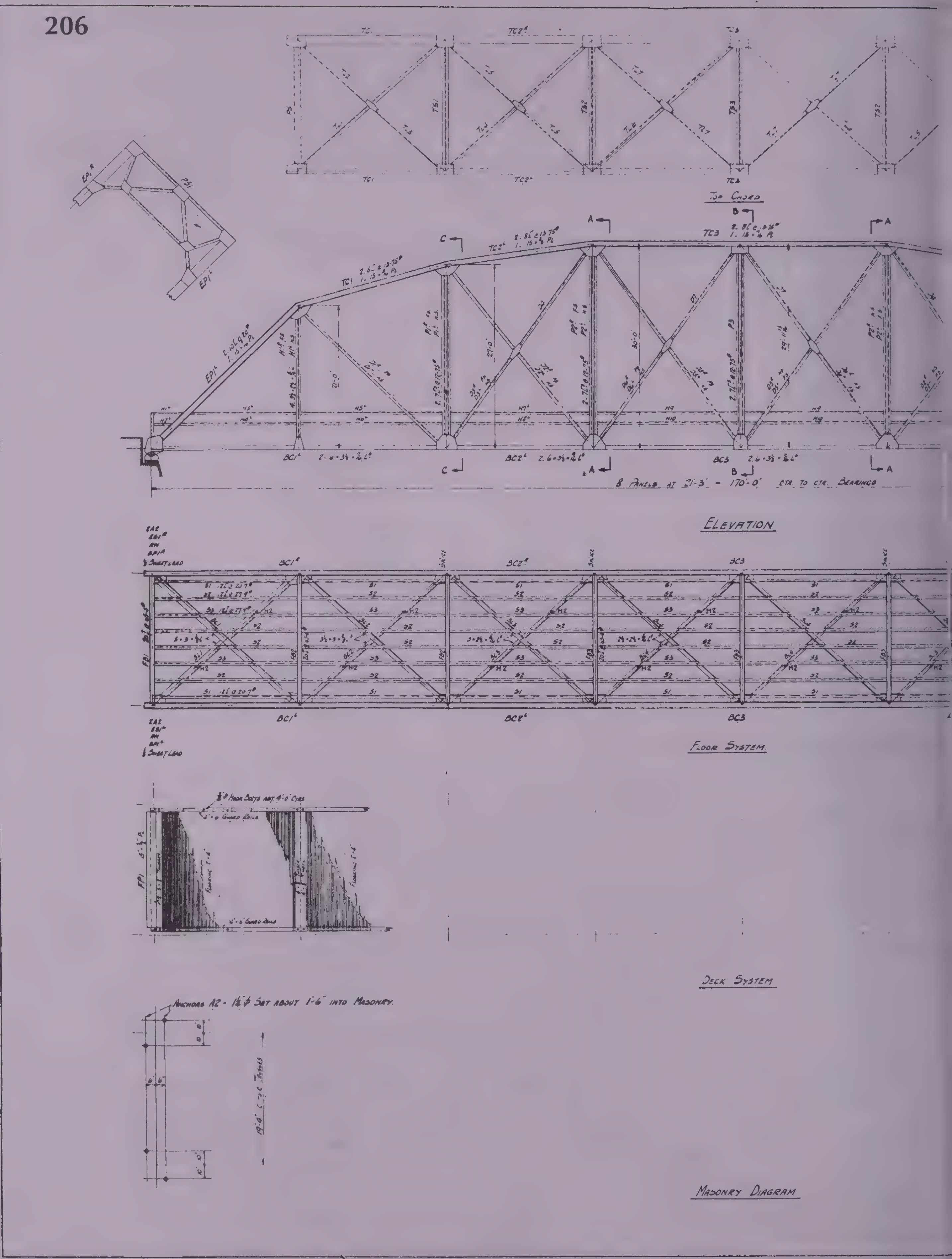
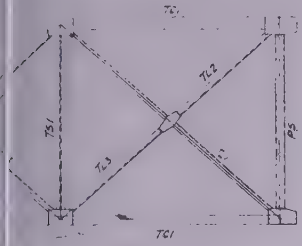


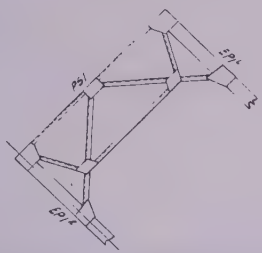
PLATE No. 29
110'6"
ELEV BASE COLUMN 82.00
ELEV PILE CUT OFF 76.00.
ELEV BASE FOOTING 74.00.
PILES 16.0
PILES 26.0 LONG
ELEVATION.
SCALE 1" = 8'
MASS CONCRETE.
END ELEV FOOTING.
C ROADWAY
PLAN OF COLUMN.
18.0' ROADWAY
ALL "W" CROSS RODS ½" x 5'
GROUND LINE
ELEV 74.00
Pier checked for stability, Sept. 30, 1936, under conditions of: Full Live Load, Dead Load, Ice Run at El. 90.61, and found to be substantial.
Bridge Engineer, Good Roads Board.
ALL VERTICAL REINFORCING RODS TO BE SET 1.0' IN FOOTING.
VOLUME IN COLUMN 120 CUB YARDS.
SIDE ELEVATION COLUMN.
SCALE 1" = 4'
CUBIC YARDS.
LINEAL FT
TOTAL FT 1952
SACKS CEMENT
TOTAL 1575 SACKS
CUBIC YDS
= 440 CU YDS
1" STRAIGHT IRON 2166 LBS
½" 130
1" 2028
⅜" 130
TOTAL REINFORCING IRON 4454 LBS
10' LONG WEIGHT 270 LBS.
USED.
2-108' C
WITH 24
FLOOR SYSTEM
9 TO BENT 4 x 16
2" x 4" TREATED TIM
PLAN OF LENS BRIDGE OVER SWAN RIVER
NORTH OF SEC 34. T'P 38. R'GE 25 W.
MINITONAS MUN & UNORGANIZED.
MANITOBA.
2-108' C to C STEEL SPANS ON CONCRETE.
221 FEET LENGTH OVERALL.
29
APPROVED
CHIEF ENGINEER.
RECLAMATION BRANCH.
DESIGNED BY A. H. Corbett.

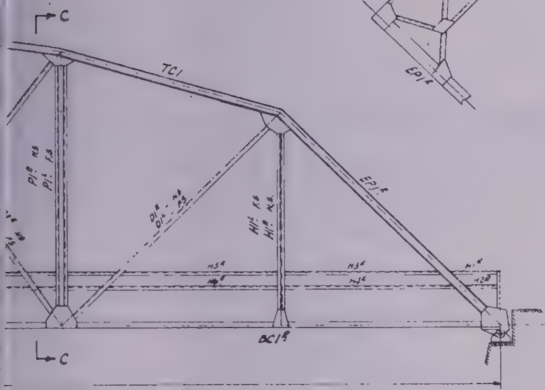


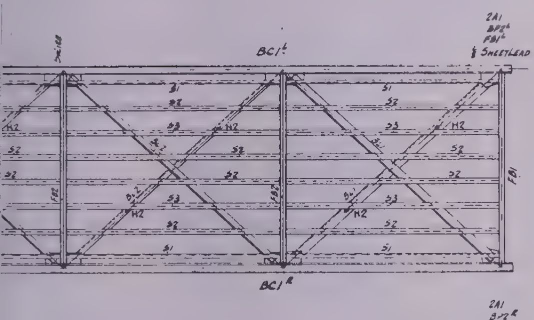
Top Chord
8 Panels at 21'-3" = 170'-0" Ctr. to Ctr. Bearings
Elevation
Floor System
Deck System
Anchors A2 - 1¼" ϕ Set about 1'-6" into Masonry.
19'-6" C. to C. Trusses
Masonry Diagram

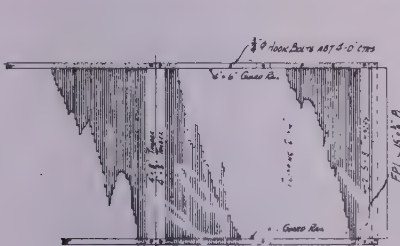
PLATE No. 30



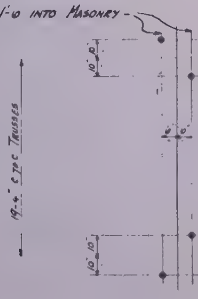






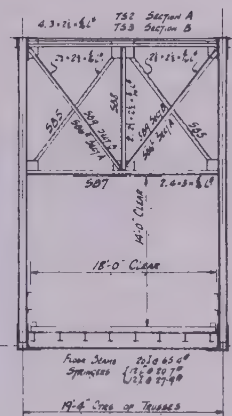


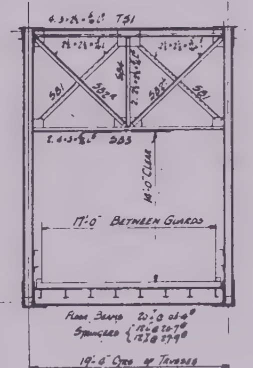
Anchors A1 - 1¼″ φ Set abt. 1′-0 into Masonry



TIMBER

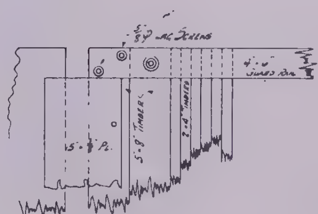
Nº	Material	Nº	Material
4	5″×8 Nº1 Fir @ 18′-0″ Lg.	192	½″ φ Bolts @ 7¾ Lg
14	4″×8″ " " @ 18′-0″ Lg.	96	¾″ φ Hook Bolts @ 11¼ Lg
20	4″×6″ - - @ 18′-0″ Lg S1	8	⅝″ φ Lag Screws @ 8 Lg
1200	2″×4″ - - @ 18′-0″ Lg S1S1E	8	O.G. Washer (C.I.) for ⅝ φ
192	3″×6″ " - @ 8″ Lg.	96	O.G. " " " ¾ φ
32	3″×8″ " " @ 19′-9″ Lg.	192	½″ Cut Washers for ½ φ Bolts
78.	1″×6″ - - @ 1′-0″ Lg.	14	¾ φ C.S.K. Bolts @ 7½″ Lg.
	Tarvia.	155 lb	20d Com. Wire Nails @ 4″ Lg

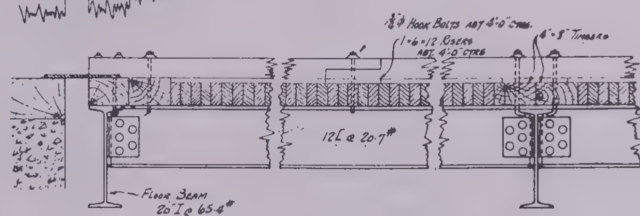




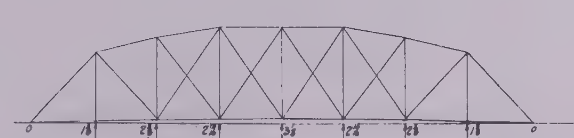
SECTIONS A & B

SECTION C.





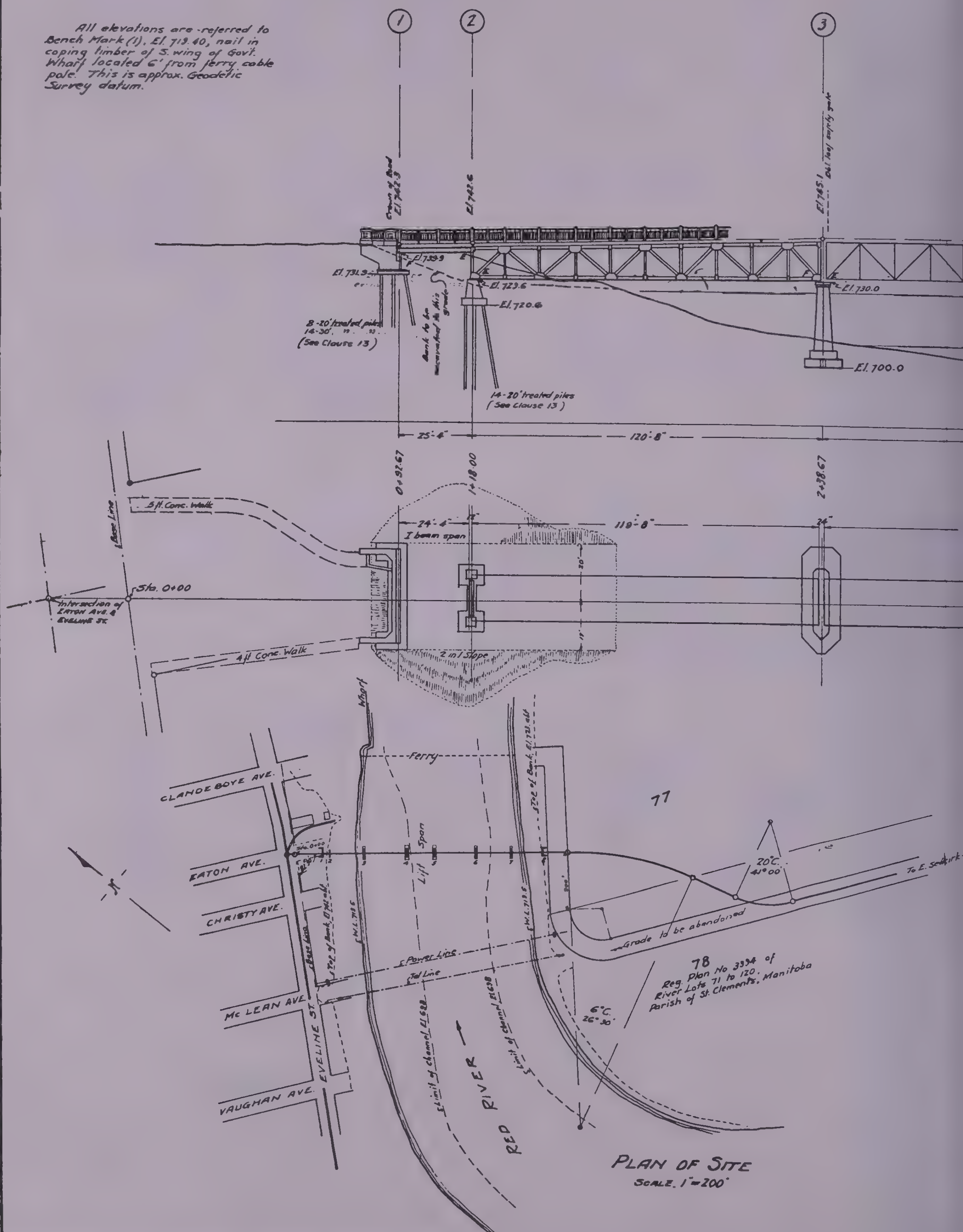
DETAIL OF DECK FLOORING

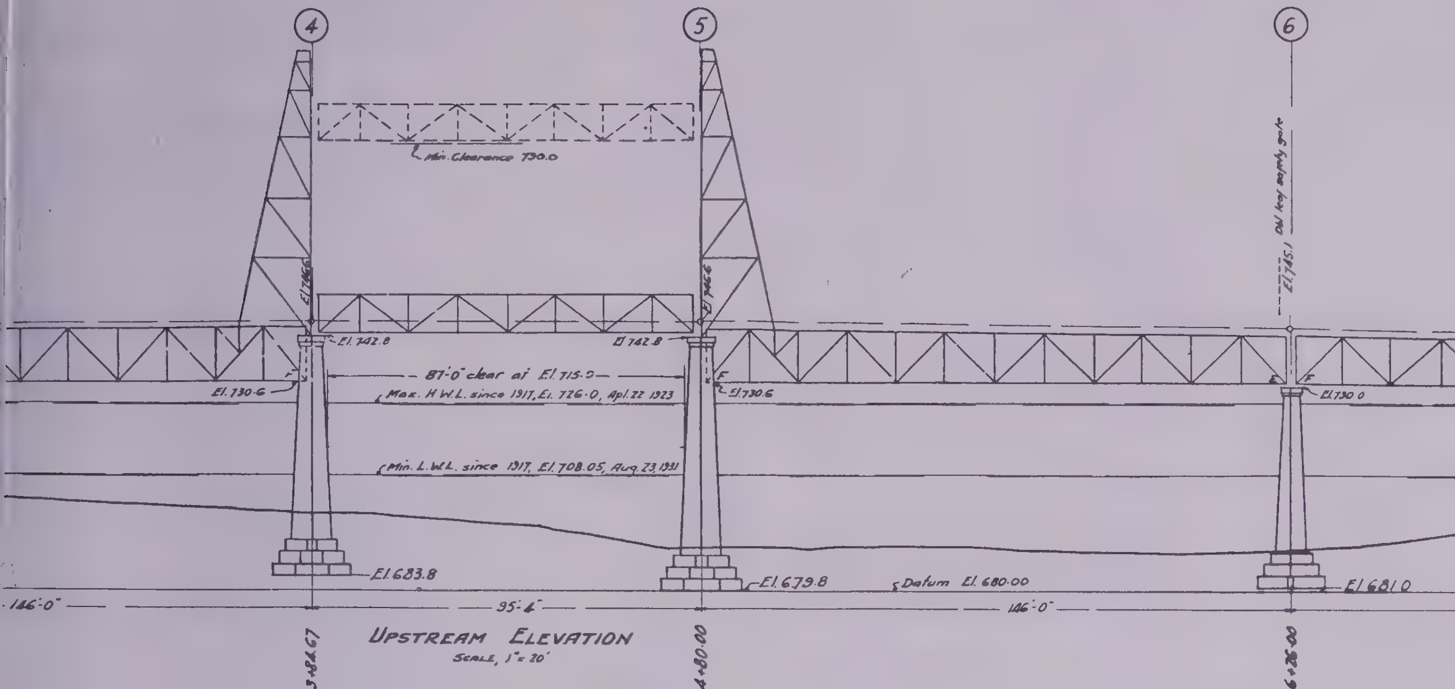


CAMBER DIAGRAM

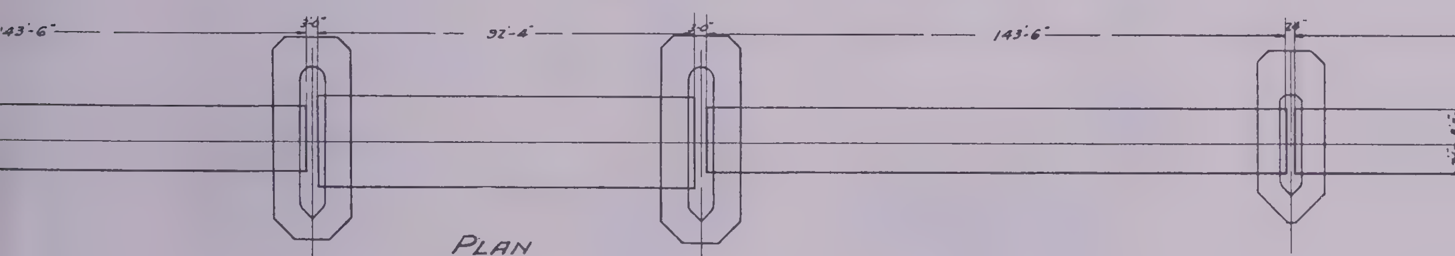
Number of Spans	Location	Date	Contract
1.	Virden Man.	4th Feb '25	W1975

Mun. of Woodworth
Std. 170 ft. Highway Span
Description 18′-0″ Roadway
Purchaser Mun of Woodworth
Erection Diagram
JNGP 18th Mar 25
W1975 E1

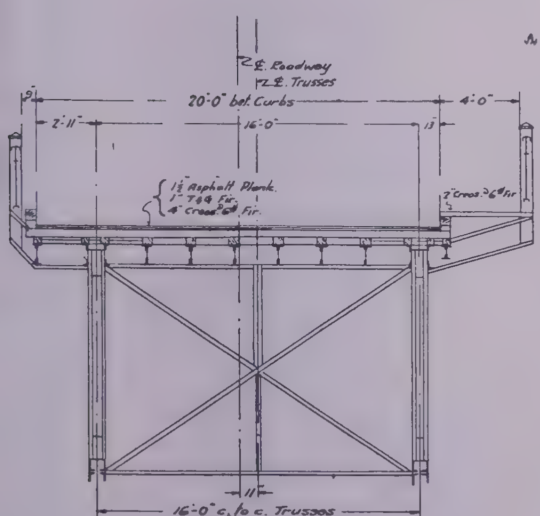

All elevations are referred to Bench Mark (1), El. 713.40, nail in coping timber of S. wing of Govt. Wharf located 6' from ferry cable pole. This is approx. Geodetic Survey datum.
El. 700.0
14-20' treated piles (See Clause 13)
(See Clause 13)
25'-4"
120'-8"
0+92.67
1+18.00
2+38.67
24'-4"
119'-8"
I beam span
5 ft. Conc. Walk
Sta. 0+00
Intersection of EATON AVE. & EVELINE ST.
4 ft. Conc. Walk
2 in 1 Slope
Wharf
Ferry
CLANDEBOYE AVE.
EATON AVE.
CHRISTY AVE.
Mc LEAN AVE.
VAUGHAN AVE.
EVELINE ST.
77
78
Lift Span
Grade to be abandoned
Power Line
Tel Line
Reg. Plan No 3334 of River Lots 71 to 120. Parish of St. Clements, Manitoba
RED RIVER
PLAN OF SITE
SCALE 1" = 200'



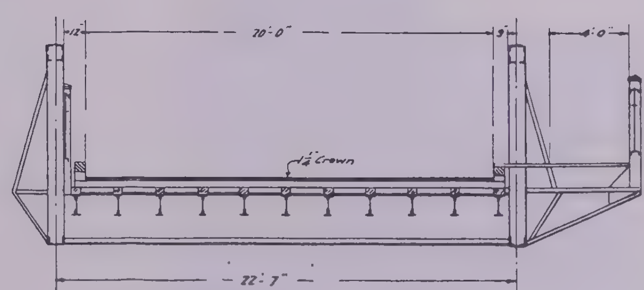
UPSTREAM ELEVATION
SCALE, 1" = 20'



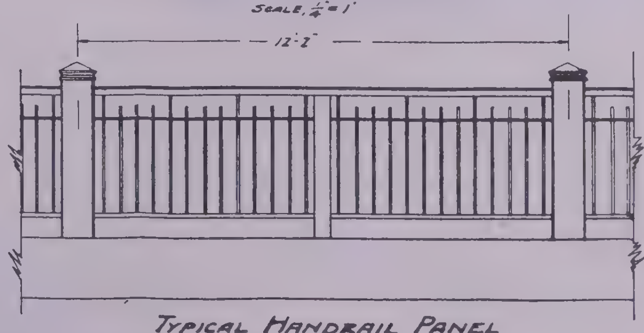
PLAN
SCALE, 1" = 20'



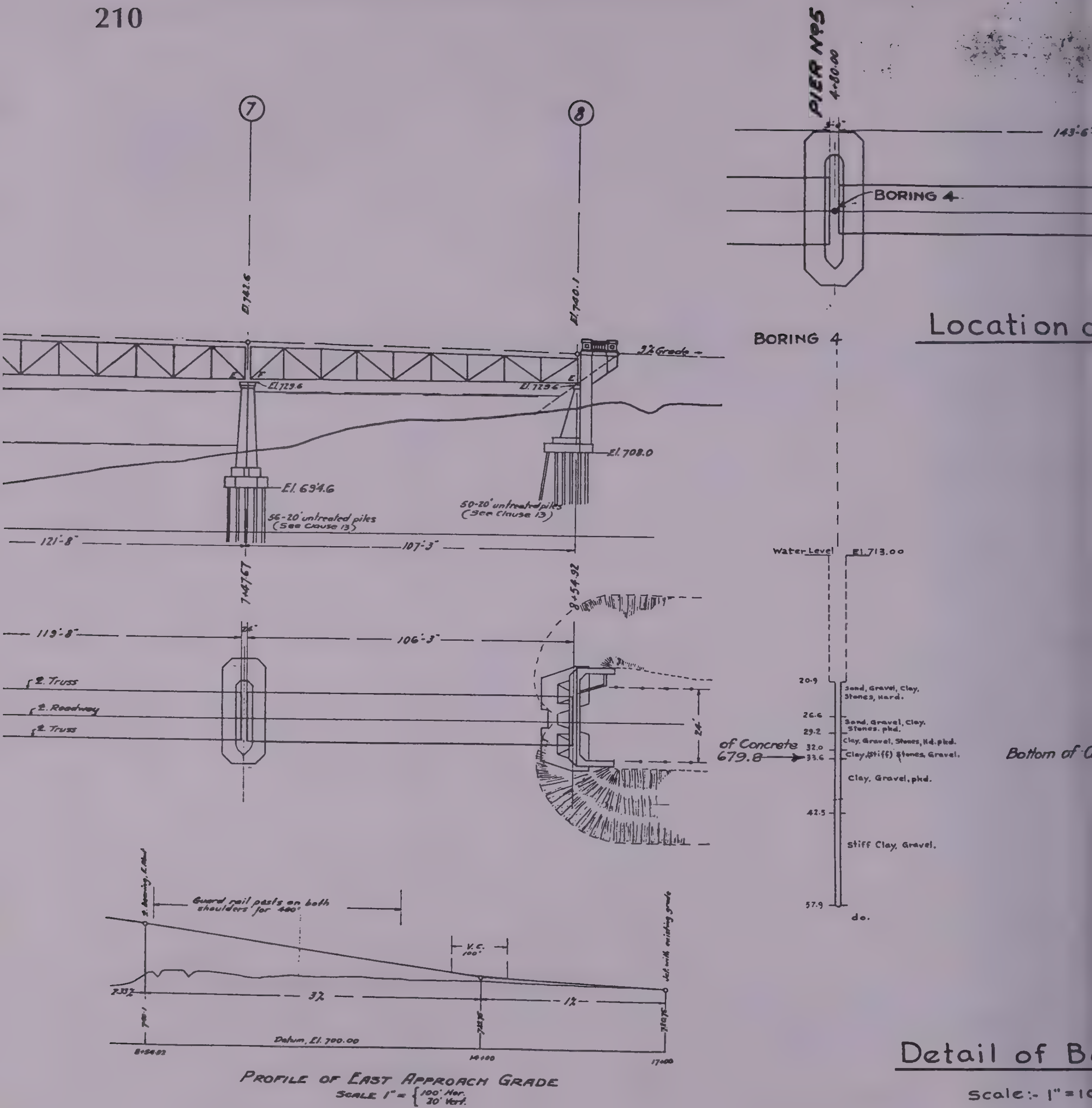
CROSS SECTION- FIXED SPANS
SCALE, ¼" = 1'



CROSS SECTION- LIFT SPAN
SCALE, ¼" = 1'

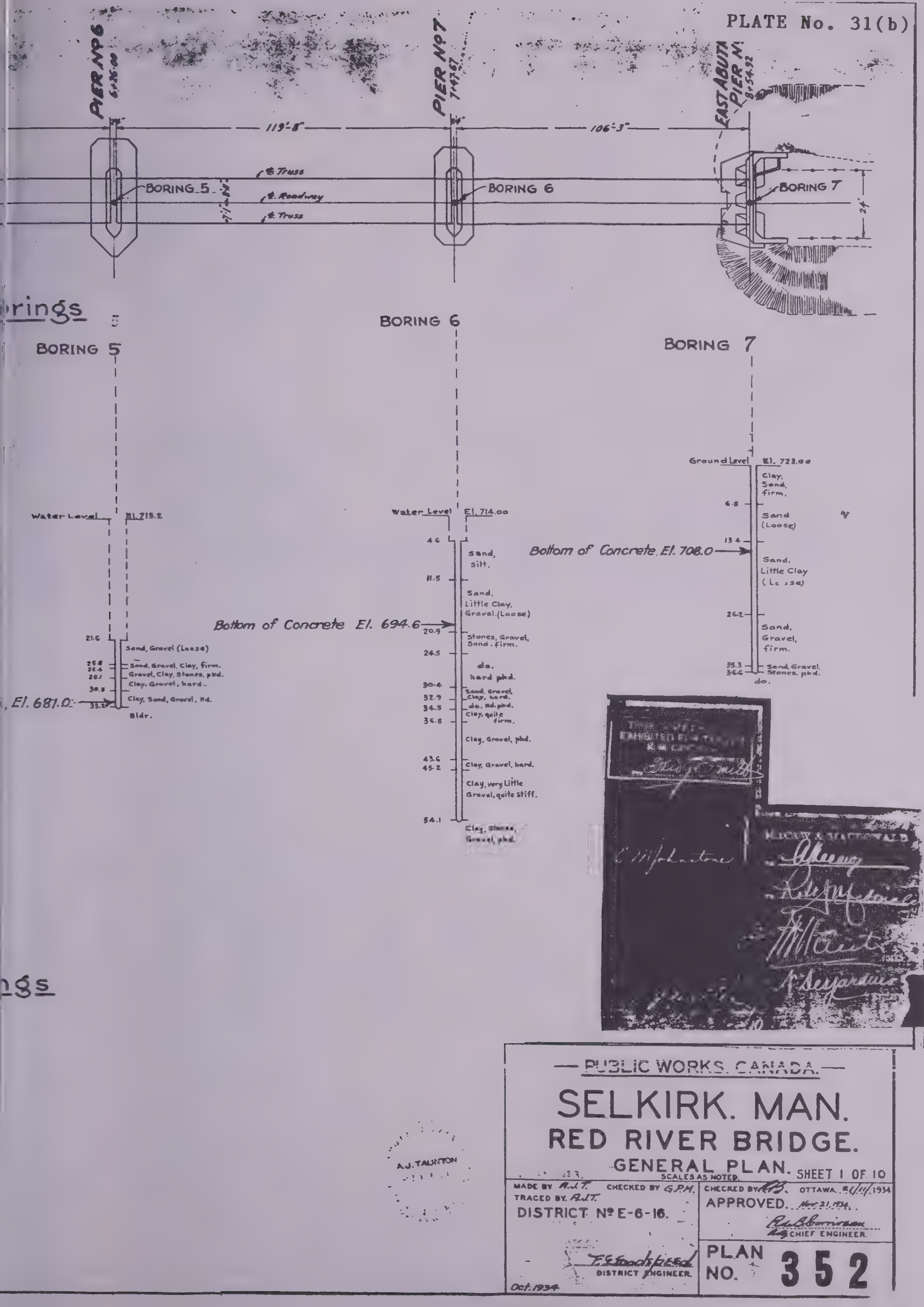


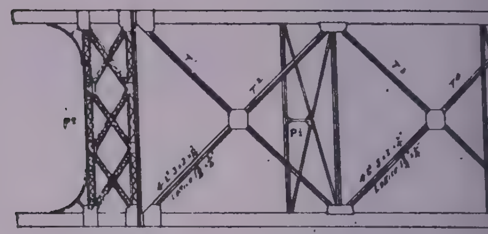
TYPICAL HANDRAIL PANEL
SCALE, ½" = 1'

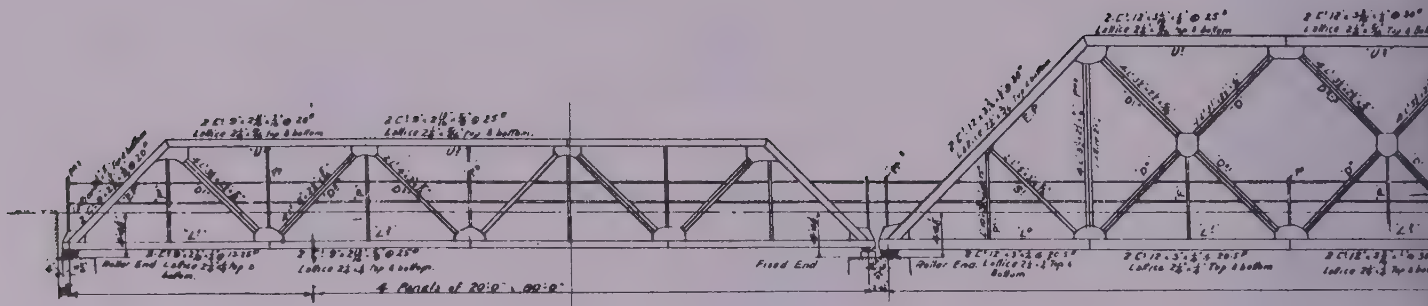


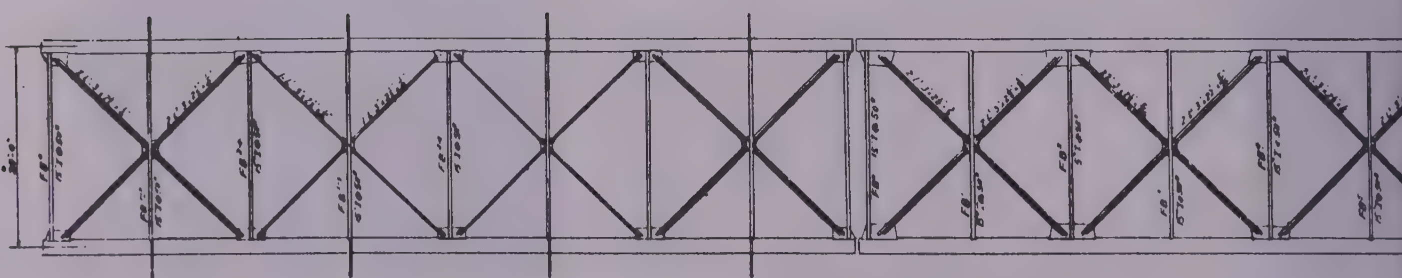
PIER Nº5
4+80.00
143'-6
BORING 4
Location o
BORING 4
⑦
⑧
El.742.6
El.740.1
3% Grade
El.729.6
El.729.6
El.708.0
El.694.6
50-20' untreated piles (See Clause 13)
56-20' untreated piles (See Clause 13)
121'-8"
107'-3"
7+47.67
8+54.92
119'-8"
106'-3"
℄ Truss
℄ Roadway
℄ Truss
24'
of Concrete 679.8
Water Level
El.713.00
20.9
Sand, Gravel, Clay, Stones, Hard.
26.6
Sand, Gravel, Clay, Stones. pkd.
29.2
Clay, Gravel, Stones, Hd.pkd.
32.0
33.6
Clay, (Stiff) Stones, Gravel.
Clay, Gravel, pkd.
42.5
Stiff Clay, Gravel.
57.9
do.
Bottom of C
Guard rail posts on both shoulders for 400'
V.C. 100'
3%
1%
Datum, El. 700.00
8+54.92
14+00
17+00
PROFILE OF EAST APPROACH GRADE
SCALE 1" = { 100' Hor. 30' Vert.
Detail of B
Scale:- 1" = 1

PLATE No. 31(b)


PIER Nº6
PIER Nº7
EAST ABUTMENT PIER Nº
119'-8"
106'-3"
℄ Truss
℄ Roadway
℄ Truss
BORING 5
BORING 6
BORING 7
24'
rings
BORING 5
BORING 6
BORING 7
Ground Level El. 723.00
Clay, Sand, firm.
6.8
Sand (Loose)
13.4
Bottom of Concrete El. 708.0
Sand, Little Clay (Loose)
26.2
Sand, Gravel, firm.
35.3
36.6
Sand, Gravel, Stones, phd.
do.
Water Level El. 715.2
21.6
Sand, Gravel (Loose)
Sand, Gravel, Clay, firm.
Gravel, Clay, Stones, phd.
Clay, Gravel, hard.
30.5
El. 681.0
Clay, Sand, Gravel, hd.
Bldr.
Water Level El. 714.00
4.6
Sand, silt.
11.5
Sand, Little Clay, Gravel (Loose)
Bottom of Concrete El. 694.6
20.9
Stones, Gravel, Sand, firm.
24.5
do. hard phd.
30.4
Sand, Gravel
32.9
Clay, hard.
34.5
do. hd. phd.
Clay, quite firm.
36.8
Clay, Gravel, phd.
43.6
45.2
Clay, Gravel, hard.
Clay, very Little Gravel, quite stiff.
54.1
Clay, Stones, Gravel, phd.
ngs
A.J. TAUNTON
— PUBLIC WORKS, CANADA. —
SELKIRK. MAN.
RED RIVER BRIDGE.
GENERAL PLAN.
SCALES AS NOTED.
SHEET 1 OF 10
MADE BY A.J.T.
CHECKED BY G.P.M.
TRACED BY A.J.T.
CHECKED BY
OTTAWA 21/11/1934
APPROVED. Nov. 21, 1934.
CHIEF ENGINEER
DISTRICT Nº E-6-16.
DISTRICT ENGINEER
Oct. 1934
PLAN NO. 352

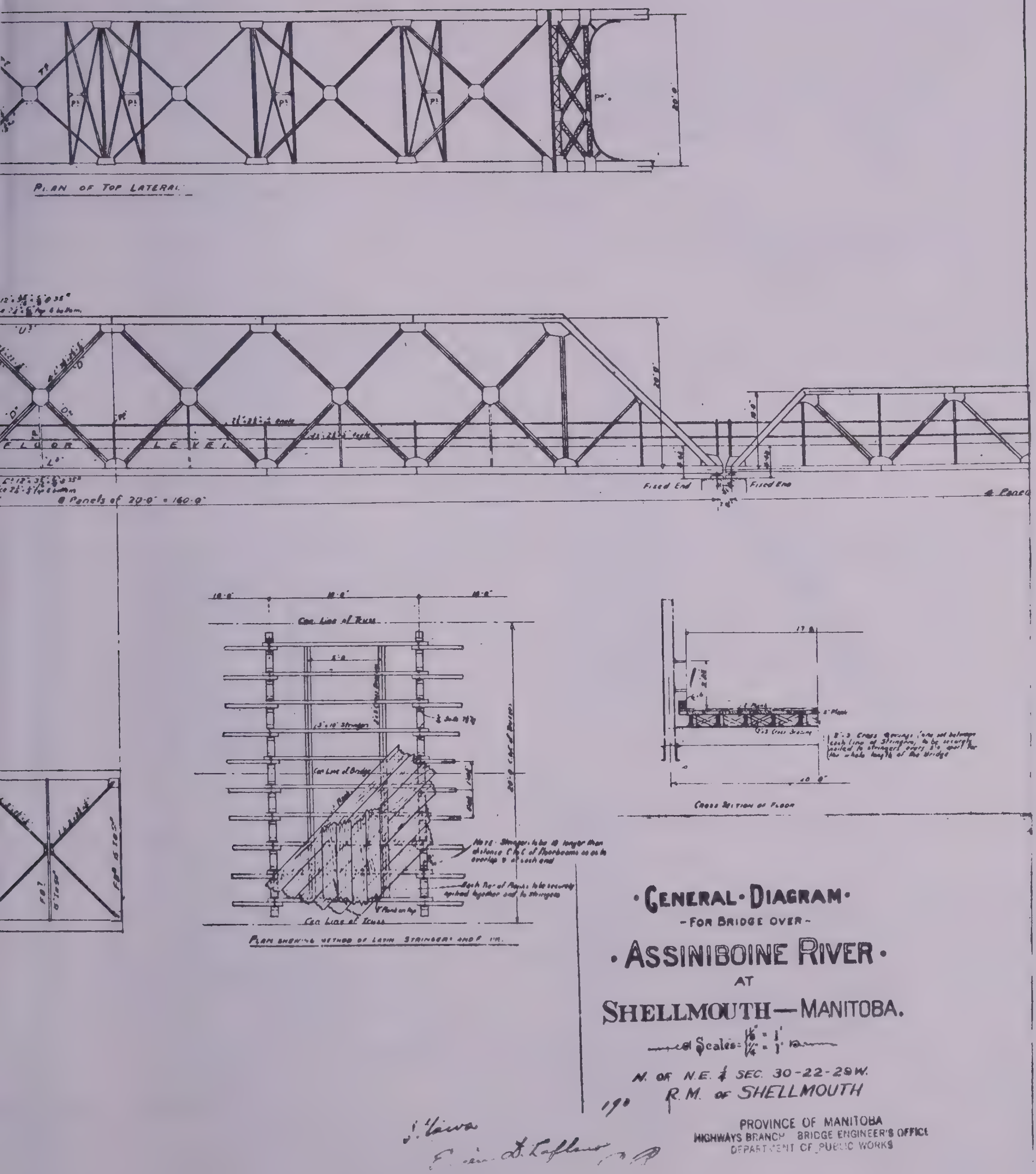






PLAN OF BOTTOM LATERALS

PLATE No. 32(a)


PLAN OF TOP LATERAL
8 Panels of 20'0" = 160'0"
Fixed End
Fixed End
FLOOR LEVEL
Cen. Line of Truss
Cen. Line of Bridge
Cen. Line of Truss
PLAN SHOWING METHOD OF LAYING STRINGERS AND FLOORING
CROSS SECTION OF FLOOR
·GENERAL·DIAGRAM·
-FOR BRIDGE OVER-
·ASSINIBOINE RIVER·
AT
SHELLMOUTH—MANITOBA.
N. OF N.E. ¼ SEC. 30-22-29W.
R.M. OF SHELLMOUTH
PROVINCE OF MANITOBA
HIGHWAYS BRANCH BRIDGE ENGINEER'S OFFICE
DEPARTMENT OF PUBLIC WORKS

PU[214]IC WORKS CANADA PROPOS

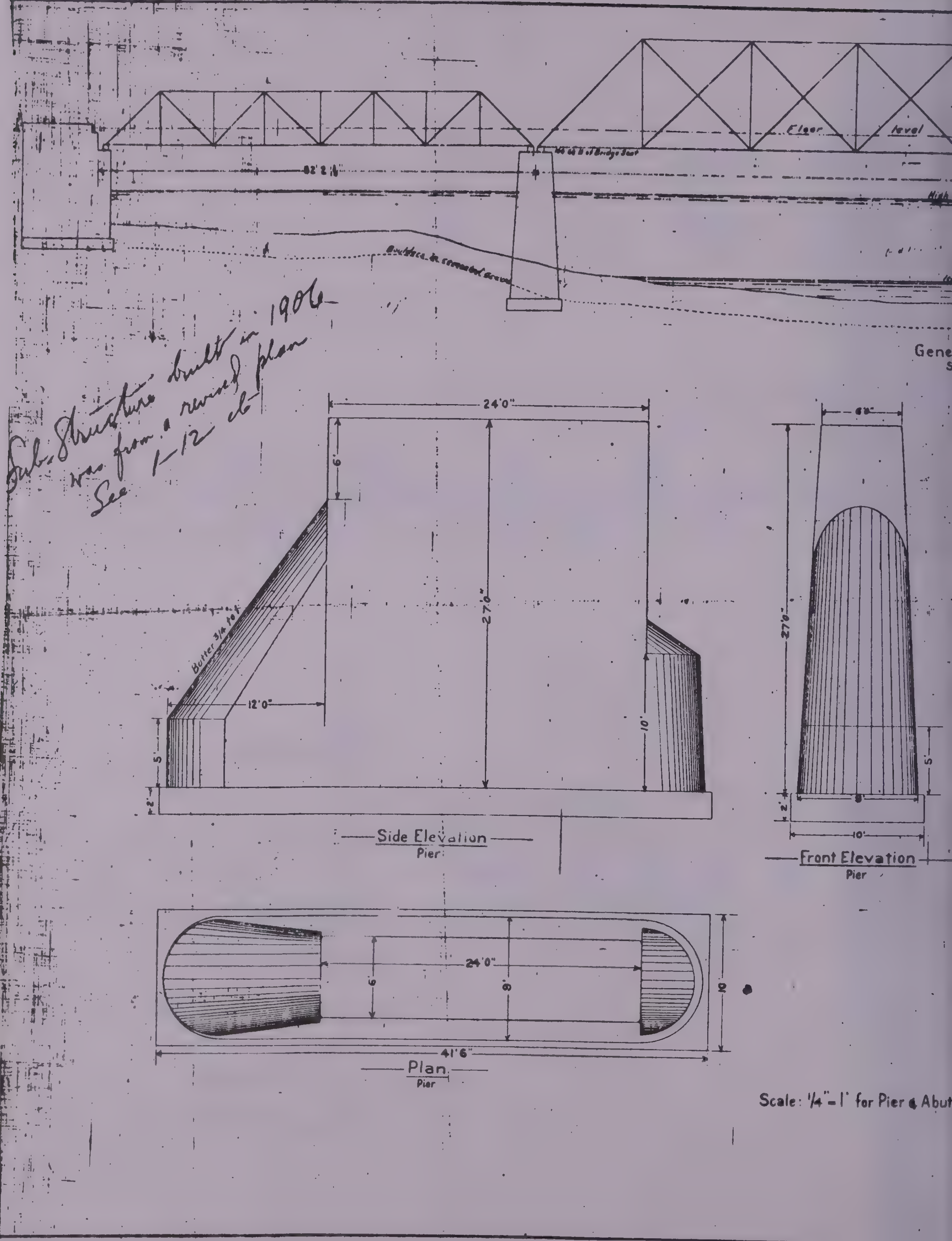
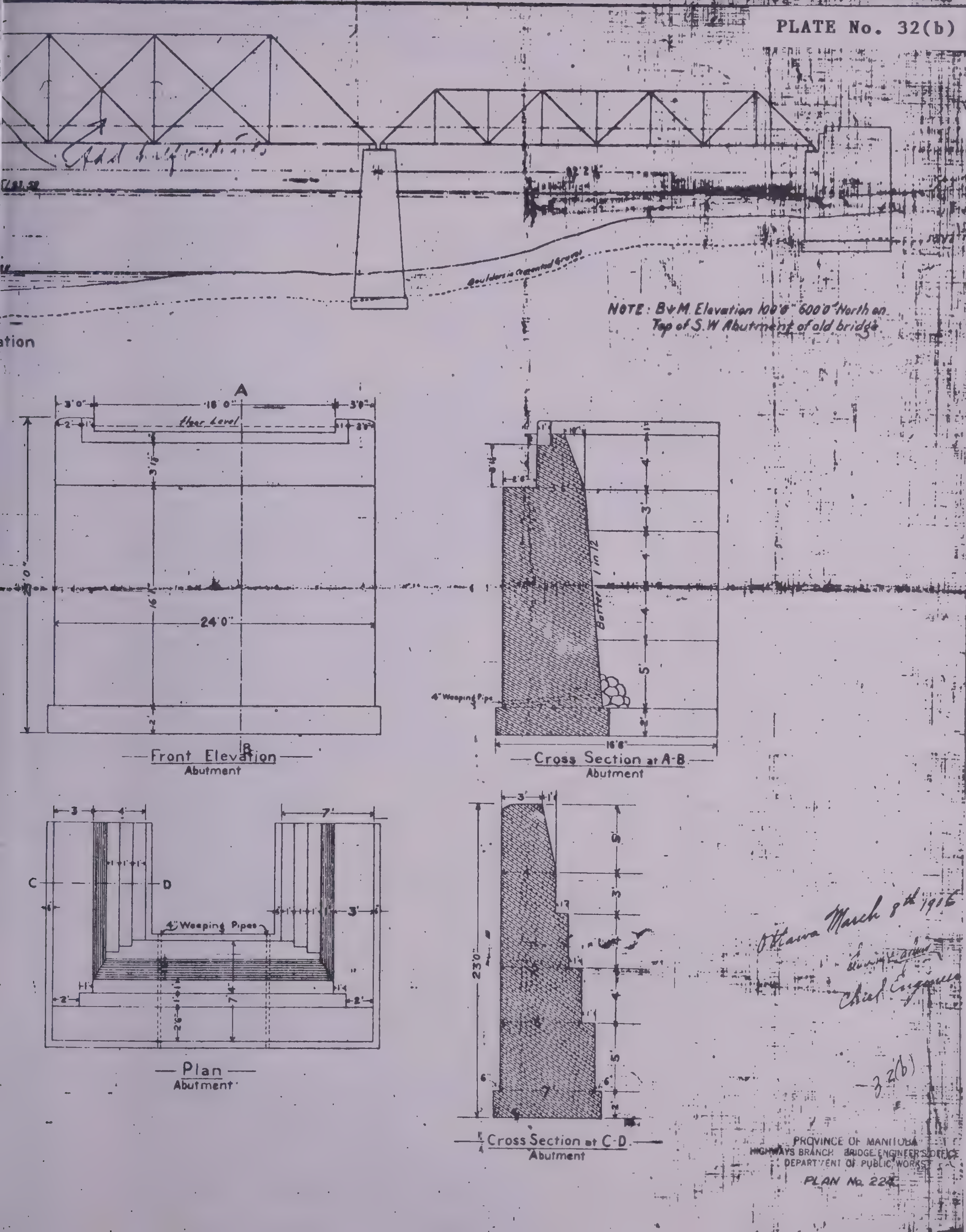
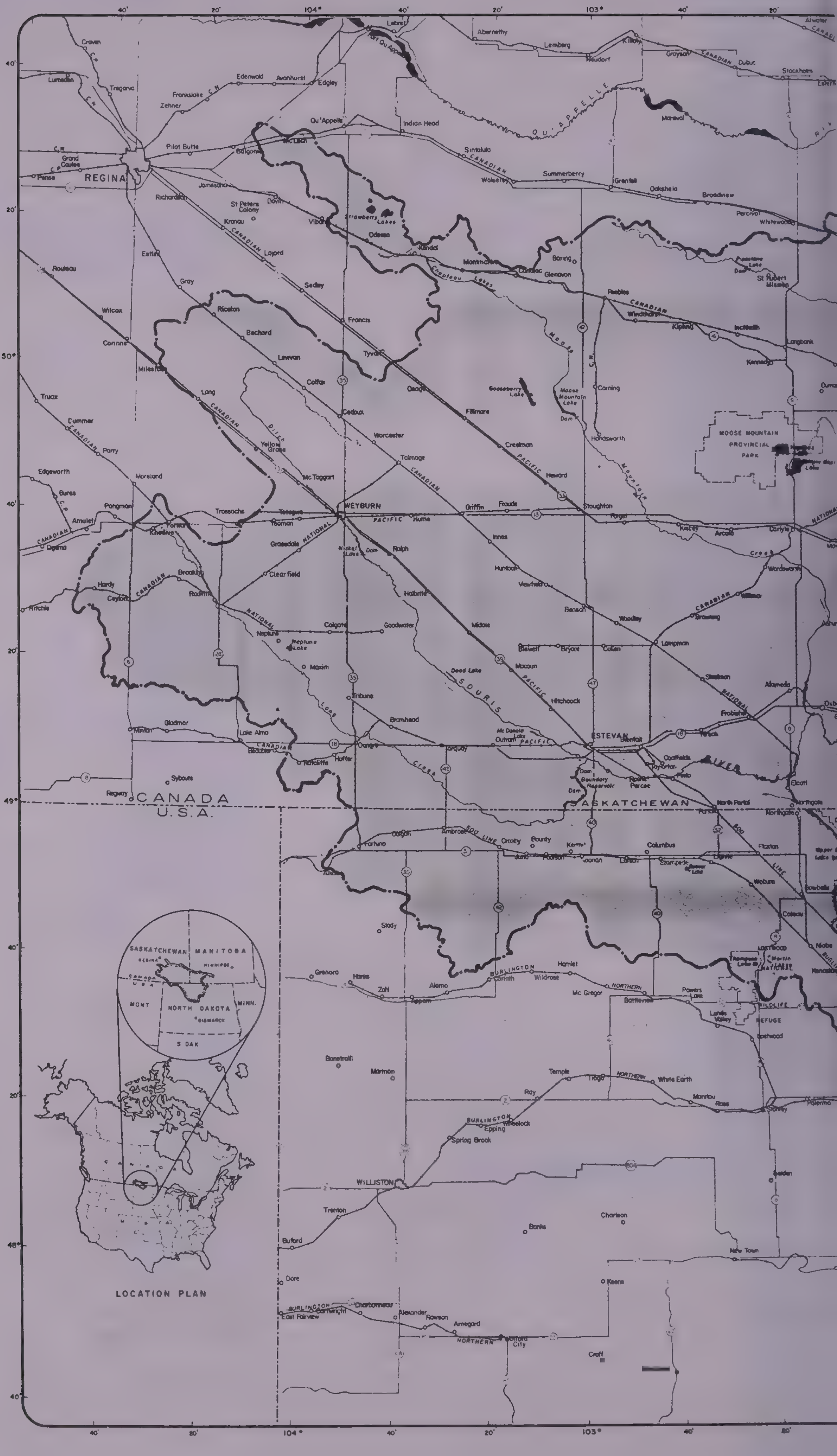


PLATE No. 32(b)

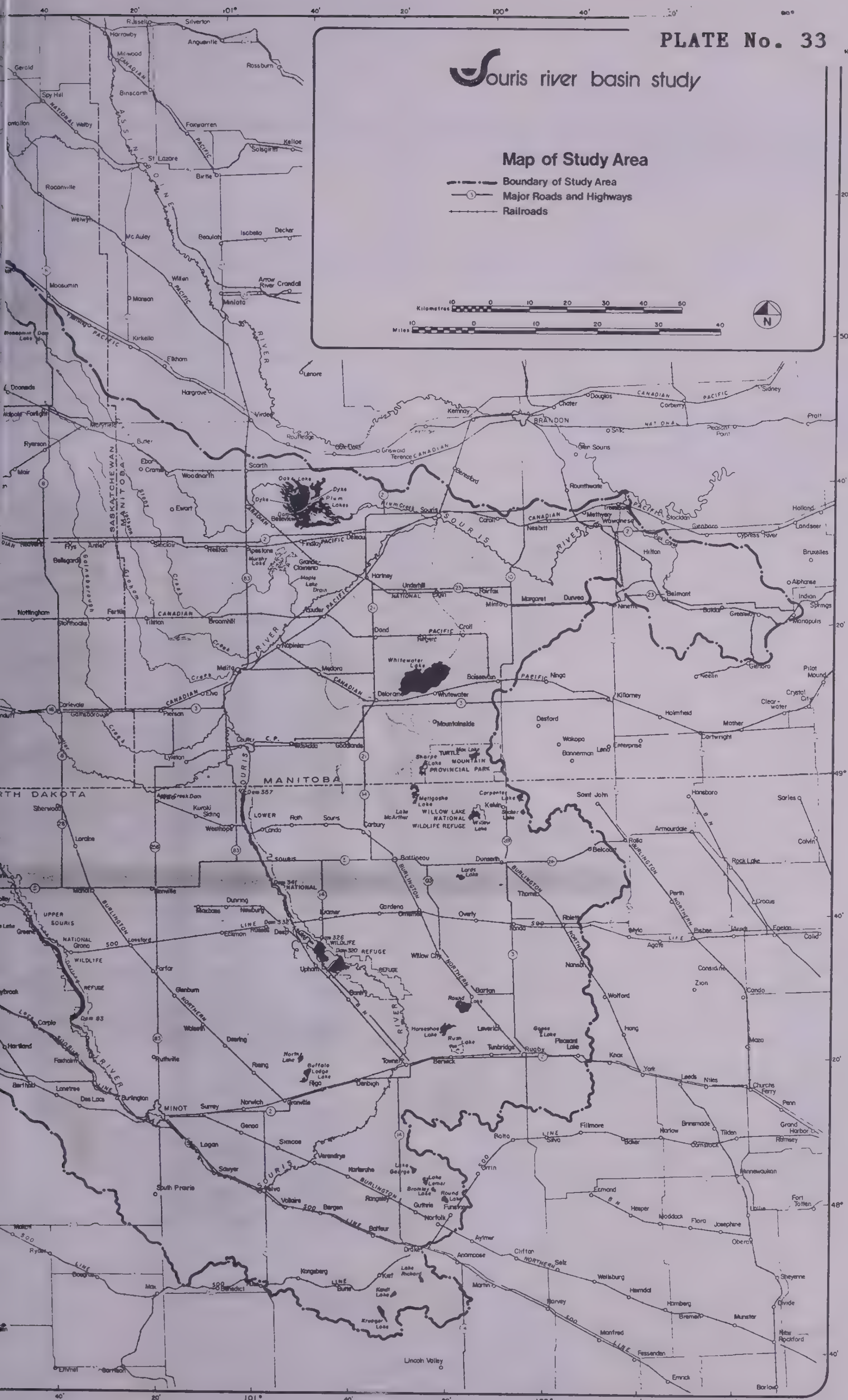


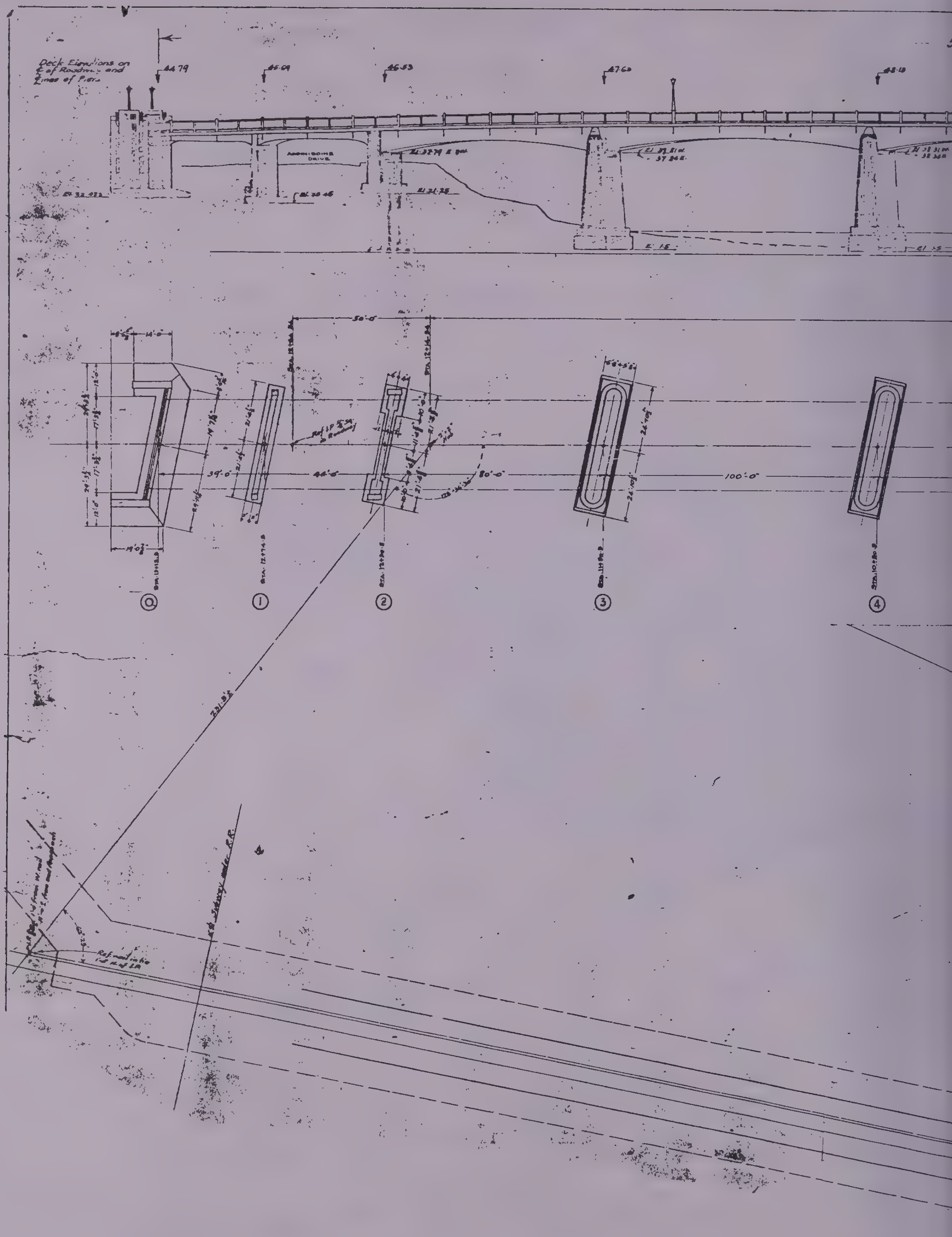
NOTE: B&M Elevation 100'0" 600'0" North on Top of S.W Abutment of old bridge
ation
A
Floor Level
24'0"
B
Front Elevation
Abutment
Batter 1 in 12
4" Weeping Pipe
16'6"
Cross Section at A-B
Abutment
C
D
4" Weeping Pipes
Plan
Abutment
23'0"
Cross Section at C-D
Abutment
Ottawa March 8th 1916
Chief Engineer
PROVINCE OF MANITOBA
HIGHWAYS BRANCH BRIDGE ENGINEER'S OFFICE
DEPARTMENT OF PUBLIC WORKS
PLAN No. 224

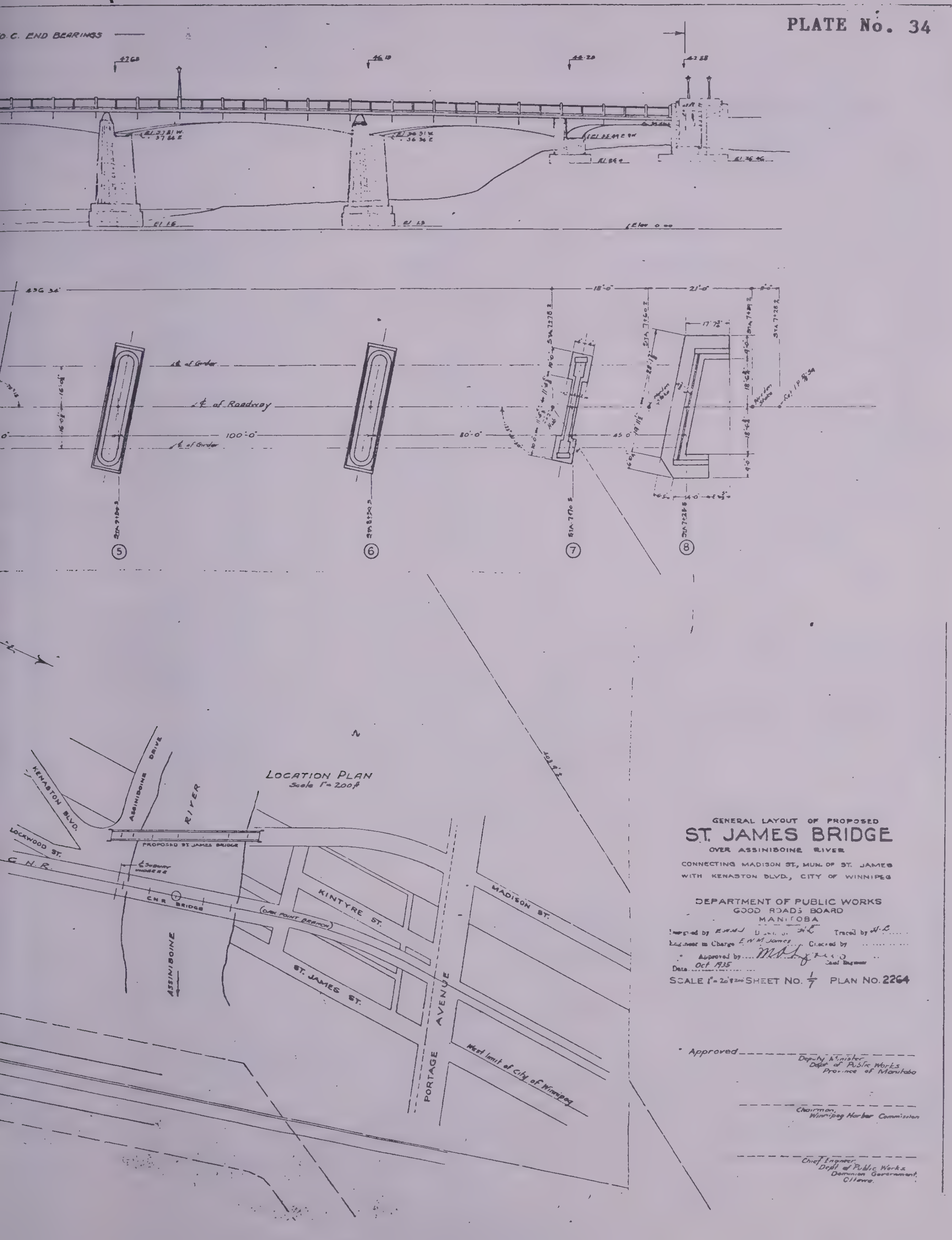


REGINA
WEYBURN
ESTEVAN
WILLISTON
CANADA
U.S.A.
SASKATCHEWAN
MOOSE MOUNTAIN PROVINCIAL PARK
SOURIS
QU'APPELLE
CANADIAN PACIFIC
CANADIAN NATIONAL
SOO LINE
BURLINGTON NORTHERN
Indian Head
Qu'Appelle
Fort Qu'Appelle
Lebret
Abernethy
Lemberg
Balgonie
Pilot Butte
Grand Coulee
Pense
Richardson
Jameson
St Peters Colony
Kronau
Lajord
Vibank
Odessa
Kendal
Sedley
Francis
Tyvan
Osage
Fillmore
Creelman
Heward
Stoughton
Griffin
Froude
Hume
Ralph
Halbrite
Midale
Macoun
Hitchcock
Bienfait
Rouleau
Wilcox
Milestone
Truax
Edgeworth
Pangman
Amulet
Ogema
Trossachs
Yellow Grass
Mc Taggart
Colgate
Goodwater
Neptune
Maxim
Tribune
Bromhead
Torquay
Outram
Oungre
Radville
Ceylon
Minton
Gladmor
Lake Alma
Sybouts
Regway
Grenfell
Wolseley
Sintaluta
Summerberry
Broadview
Kipling
Carlyle
Arcola
Kisbey
Lampman
Alameda
North Portal
Noonan
Columbus
Crosby
Ambrose
Fortuna
Alkabo
Grenora
Zahl
Alamo
Wildrose
Hamlet
Mc Gregor
Temple
Tioga
White Earth
Ray
Epping
Wheelock
Spring Brook
Trenton
Buford
Banks
Charlson
Keene
Dore
Cartwright
Charbonneau
East Fairview
Alexander
Rawson
Arnegard
Watford City
New Town
Bonetraill
Marmon
LOCATION PLAN
SASKATCHEWAN
MANITOBA
NORTH DAKOTA
MONT
MINN.
S DAK

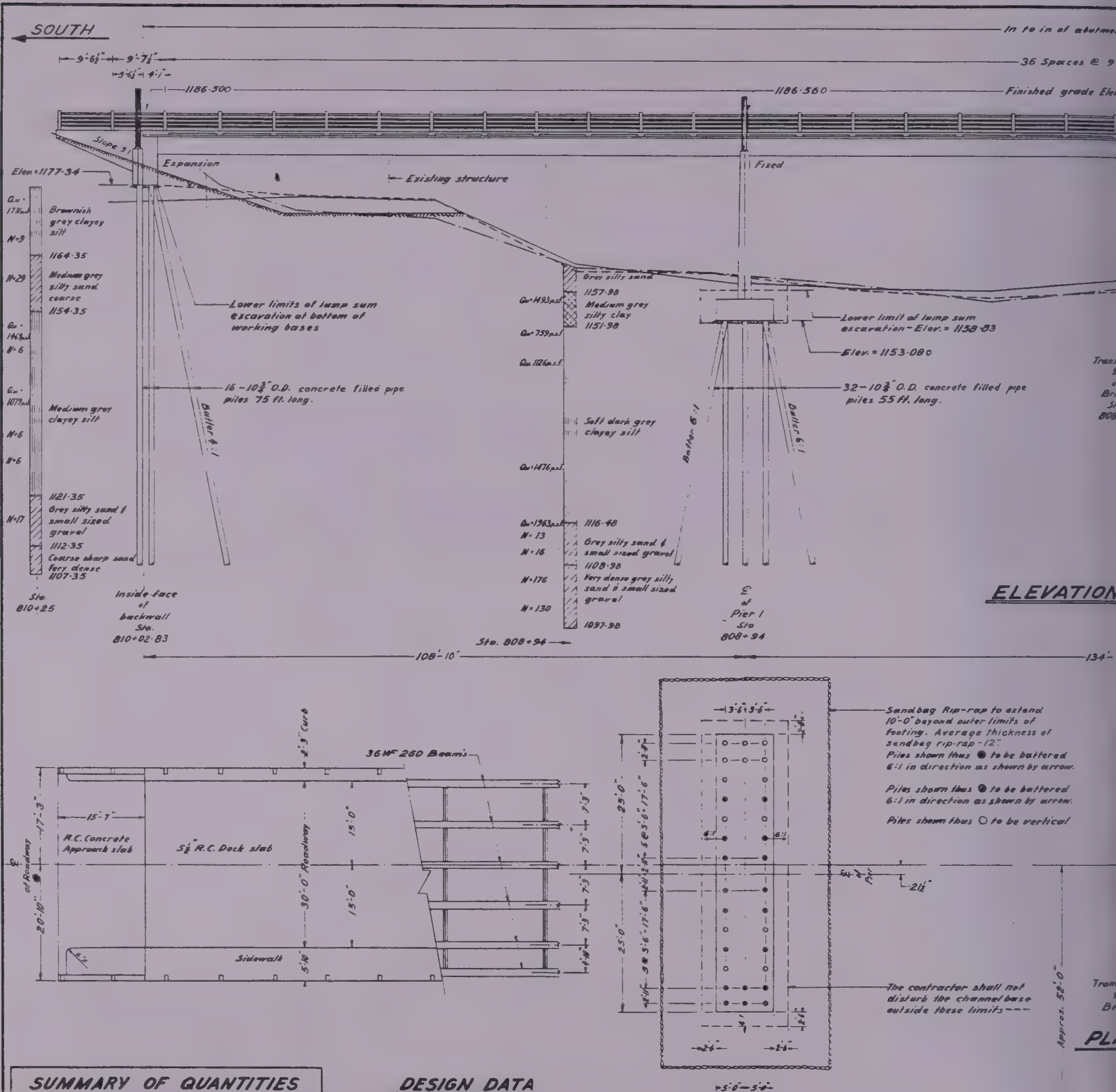
PLATE No. 33


Souris river basin study
Map of Study Area
Boundary of Study Area
Major Roads and Highways
Railroads
Kilometres
Miles
N
BRANDON
MINOT
MANITOBA
SASKATCHEWAN
TURTLE MOUNTAIN PROVINCIAL PARK
WILLOW LAKE NATIONAL WILDLIFE REFUGE
UPPER SOURIS NATIONAL WILDLIFE REFUGE
LOWER SOURIS NATIONAL WILDLIFE REFUGE


Deck Elevations on
℄ of Roadway and
Lines of Piers
44.79
45.69
46.53
47.60
ADMIRALS DRIVE
50'-0"
80'-0"
100'-0"



O.C. END BEARINGS
¢ of Girder
¢ of Roadway
100'-0"
80'-0"
45'-0"
18'-0"
21'-0"
17'-7½"
5
6
7
8
LOCATION PLAN
Scale 1"=200 ft
KENASTON BLVD.
ASSINIBOINE DRIVE
RIVER
LOCKWOOD ST.
C.N.R.
PROPOSED ST JAMES BRIDGE
C.N.R. BRIDGE
(OAK POINT BRANCH)
KINTYRE ST.
MADISON ST.
ST. JAMES ST.
ASSINIBOINE
PORTAGE AVENUE
West limit of City of Winnipeg
GENERAL LAYOUT OF PROPOSED
ST. JAMES BRIDGE
OVER ASSINIBOINE RIVER
CONNECTING MADISON ST., MUN. OF ST. JAMES
WITH KENASTON BLVD., CITY OF WINNIPEG
DEPARTMENT OF PUBLIC WORKS
GOOD ROADS BOARD
MANITOBA
Designed by E.N.M.J. Traced by H.C.
Engineer in Charge E.N.M. James Checked by
Approved by
Chief Engineer
Date Oct 1935
SCALE 1"=20' & 200' SHEET No. 1/7 PLAN No. 2264
Approved
Deputy Minister Dept. of Public Works Province of Manitoba
Chairman, Winnipeg Harbor Commission
Chief Engineer Dept. of Public Works Dominion Government, Ottawa.



SUMMARY OF QUANTITIES

MATERIAL	QUANTITY	UNIT

DESIGN DATA

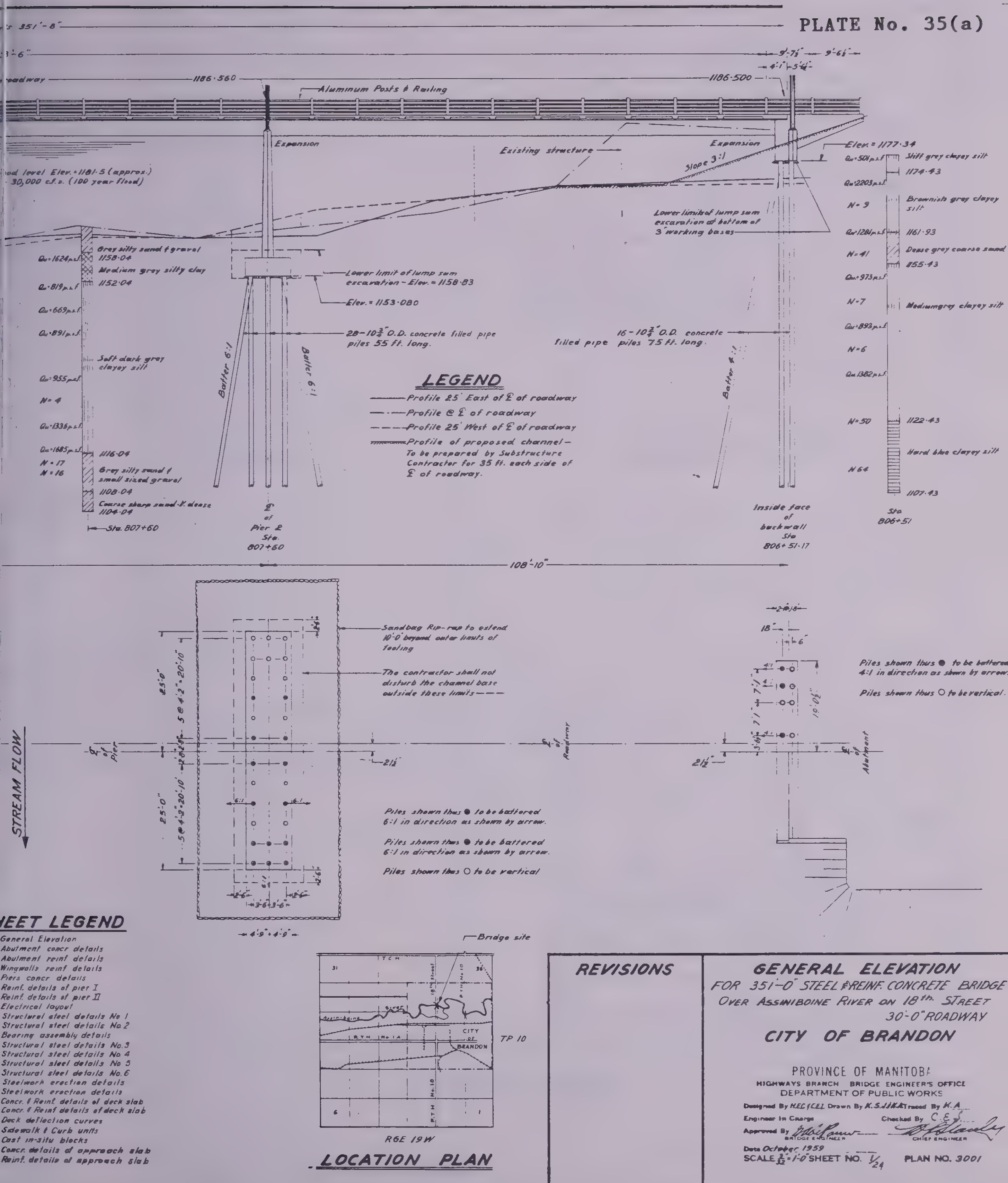
General design specification—A.A.S.H.O. 7th Edition 1957
Live loading A.A.S.H.O. H 20-S16-44
Concrete strength f'c = 3,750 p.s.i. (Substructure) 4,500 p.s.i. (Deck)
Maximum design load for piles
Abutment = 45 Kips
Pier = 66 Kips
Ice loading 127 Kips at Elev. 1178·00

GENERAL NOTES

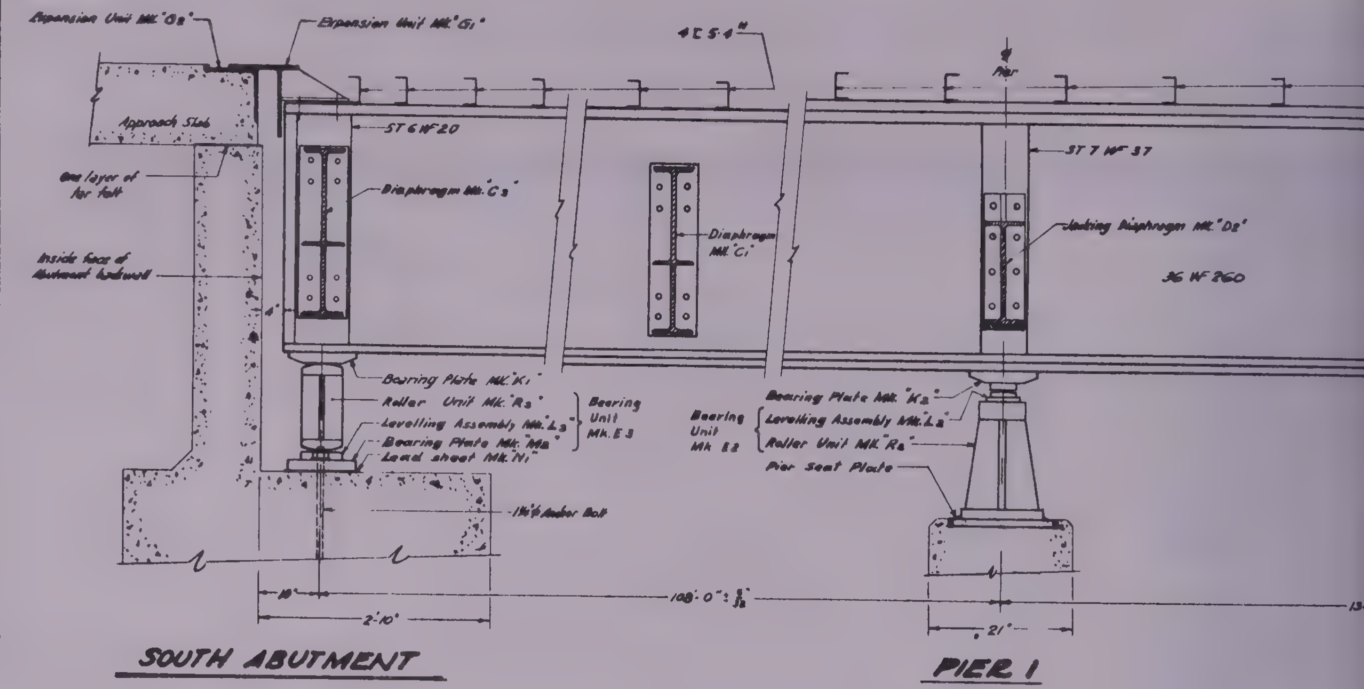
1. The following surfaces are to be given a rubbed finish:
   * a) Exposed edges of cast-in-situ and precast curb and sidewalk units
   b) Ends of piers above Elev. 1165·00 as seen in elevation.
   c) Top edges and outside faces of wingwalls above finished ground line.
   * d) Vertical face and chamfers of deck slab edges.
2. Foundation data as shown in boreholes is primarily for design purposes, and the Department does not guarantee that the information is free from errors or discrepancies.

* Items a) & d) only to be done by Deck Contractor

PLATE No. 35(a)



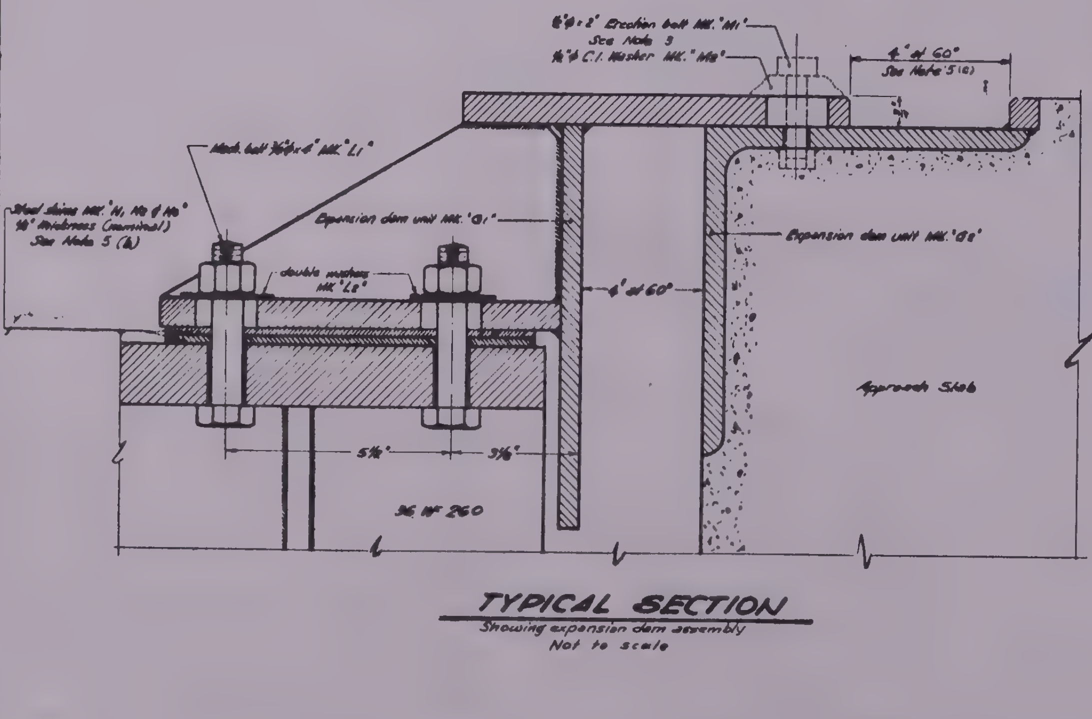
1186·560
1186·500
Aluminum Posts & Railing
Expansion
Existing structure
Slope 3:1
Elev. = 1177·34
Lower limit of lump sum excavation at bottom of 3" working bases
Lower limit of lump sum excavation - Elev. = 1158·83
Elev. = 1153·080
28-10¾" O.D. concrete filled pipe piles 55 ft. long.
16-10¾" O.D. concrete filled pipe piles 75 ft. long.
Batter 6:1
LEGEND
Profile 25' East of ℄ of roadway
Profile @ ℄ of roadway
Profile 25' West of ℄ of roadway
Profile of proposed channel - To be prepared by Substructure Contractor for 35 ft. each side of ℄ of roadway.
Grey silty sand & gravel
1158·04
Medium grey silty clay
1152·04
Soft dark grey clayey silt
1116·04
Grey silty sand & small sized gravel
1108·04
Coarse sharp sand - V. dense
1104·04
Sta. 807+60
℄ of Pier 2 Sta. 807+60
Inside face of backwall Sta 806+51·17
Stiff grey clayey silt
1174·43
Brownish grey clayey silt
1161·93
Dense grey coarse sand
855·43
Medium grey clayey silt
1122·43
Hard blue clayey silt
1107·43
Sta 806+51
108'-10"
Sandbag Rip-rap to extend 10'-0" beyond outer limits of footing
The contractor shall not disturb the channel base outside these limits
Piles shown thus ● to be battered 6:1 in direction as shown by arrow.
Piles shown thus ● to be battered 6:1 in direction as shown by arrow.
Piles shown thus ○ to be vertical
Piles shown thus ● to be battered 4:1 in direction as shown by arrow.
Piles shown thus ○ to be vertical.
STREAM FLOW
25'-0"
SHEET LEGEND
General Elevation
Abutment concr details
Abutment reinf details
Wingwalls reinf details
Piers concr details
Reinf. details of pier I
Reinf. details of pier II
Electrical layout
Structural steel details No 1
Structural steel details No 2
Bearing assembly details
Structural steel details No. 3
Structural steel details No 4
Structural steel details No 5
Structural steel details No. 6
Steelwork erection details
Steelwork erection details
Concr. & Reinf. details of deck slab
Concr. & Reinf. details of deck slab
Deck deflection curves
Sidewalk & Curb units
Cast in-situ blocks
Concr. details of approach slab
Reinf. details of approach slab
Bridge site
TP 10
CITY OF BRANDON
RGE 19W
LOCATION PLAN
REVISIONS
GENERAL ELEVATION
FOR 351'-0" STEEL & REINF. CONCRETE BRIDGE
OVER ASSINIBOINE RIVER ON 18th STREET
30'-0" ROADWAY
CITY OF BRANDON
PROVINCE OF MANITOBA
HIGHWAYS BRANCH BRIDGE ENGINEER'S OFFICE
DEPARTMENT OF PUBLIC WORKS
Date October 1959
SHEET NO. 1/24
PLAN NO. 3001



LONGITUDINA

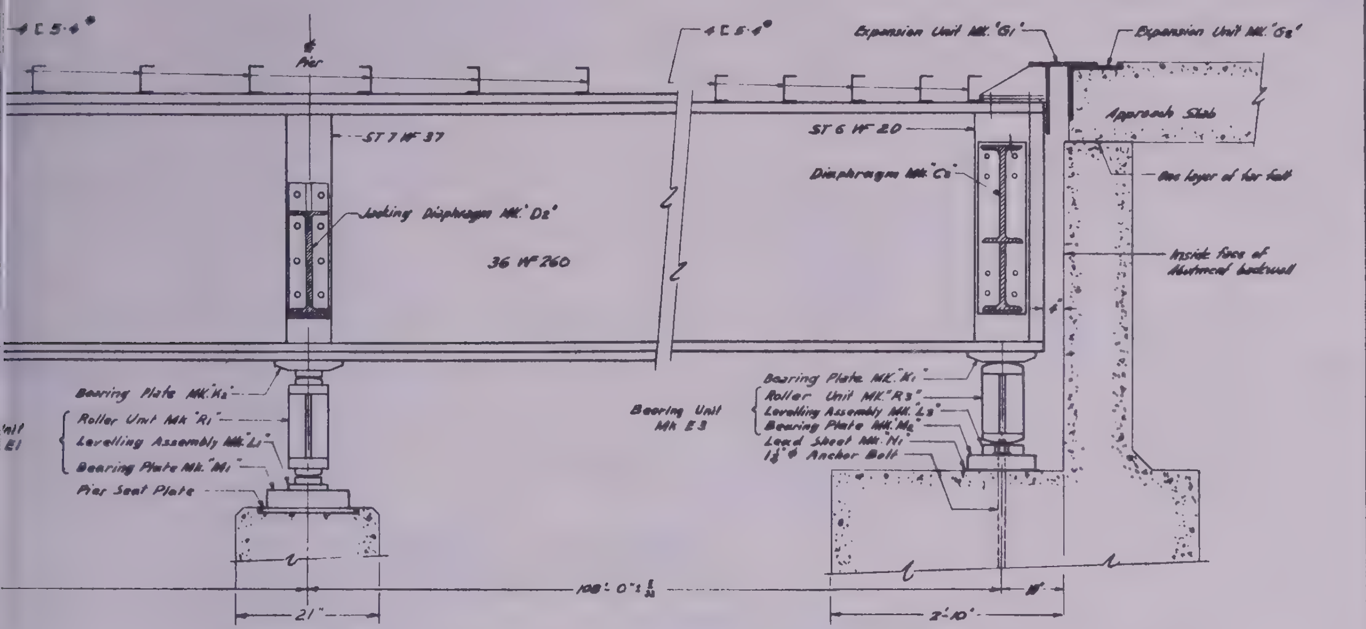
Scale: 1".

AN



TYPICAL SECTION

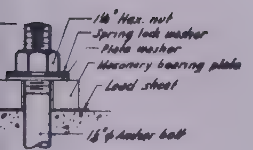
Showing expansion dam assembly
Not to scale



PIER 2

NORTH ABUTMENT

ECTION



BOLT DETAIL

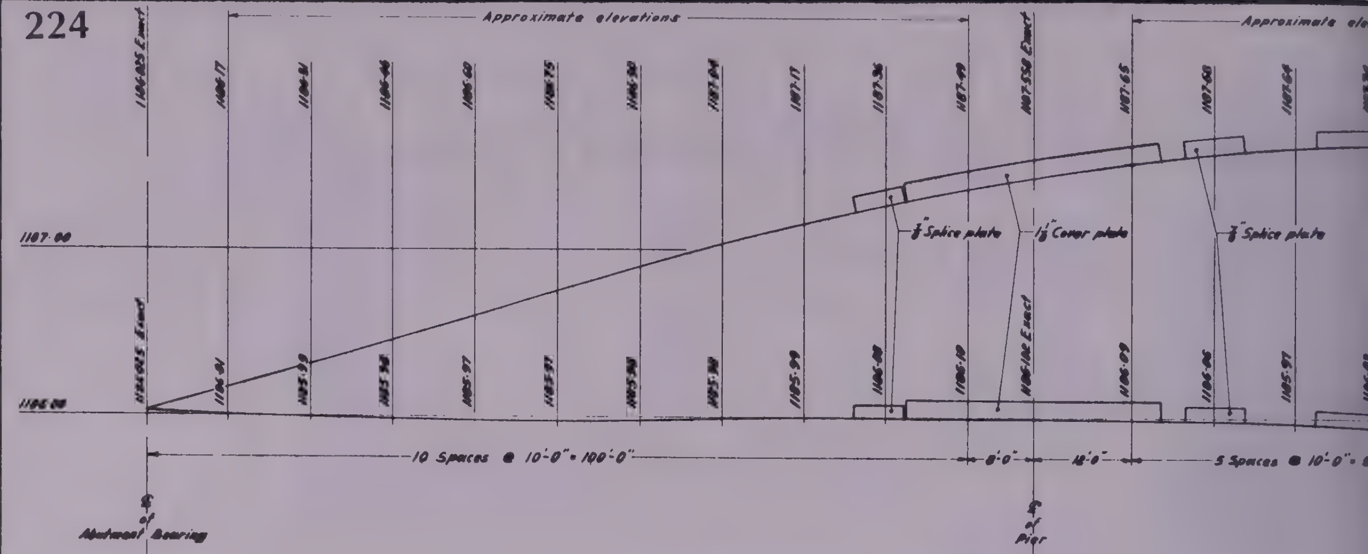
t to scale

STEELWORK ERECTION NOTES

1. Fixed pier bearing units MK. E 2 shall be accurately centred on Pier 1, but not welded to the pier seat plate.
2. Bearing units Mk."E1" and "E3" shall be assembled, but not welded on Pier 2 and the abutments and adequately secured against movement during erection of stringers and diaphragms.
3. Stringers and diaphragms shall be erected on the bearing units and the positions of bearing plates and roller units checked and adjusted for temperature, as directed by the Engineer.

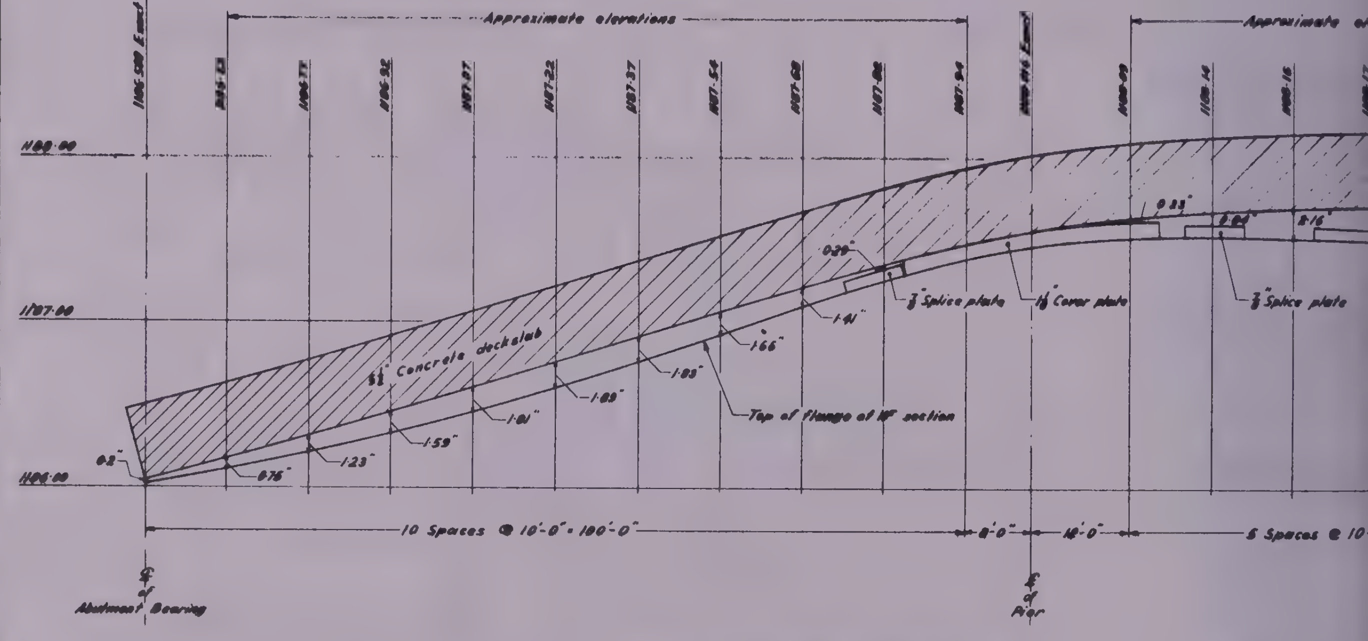
4. When stringer elevations have been checked to the satisfaction of the Engineer, the bearing units on both piers shall be marked and identified as to location, so that each unit can be returned to the same position when superstructure is lowered after deck slab is poured.
5. Expansion dam units to be erected as follows:
   (a) Units Mk."G1" shall be accurately positioned with respect to the abutment backwall (3½" gap at 60°F. compensated for stringer temperature)
   (b) Steel shims Mk."H1", "H2" and "H3" shall be inserted as required to ensure correct elevation and deck profile, and unit MK."G1" firmly bolted to stringers with bolts Mk "L1"
   (c) Units Mk."G2" to be placed by deckslab contractor after deckslab is poured.
   (d) Sidewalk and curb expansion plates Mk."S1" & "S2" to be placed with deck reinforcing steel by deckslab contractor.

REVISIONS	STEELWORK ERECTION DETAILS
Note No. 4 & 5 not applicable. February 16-1961 H.E.C.	FOR 351'-0" STEEL & R.C. BRIDGE OVER ASSINIBOINE RIVER ON 18TH STREET 30'-0" ROADWAY
	CITY OF BRANDON
	PROVINCE OF MANITOBA HIGHWAYS BRANCH BRIDGE ENGINEER'S OFFICE DEPARTMENT OF PUBLIC WORKS
	Designed By H.E.C. Drawn By J.H. Traced By T.Z.
	Engineer in Charge ______ Checked By G.E.L.
	Approved By [signature] BRIDGE ENGINEER ______ CHIEF ENGINEER
	Date DEC. 1959
	SCALE as shown SHEET NO. 7 1/16 PLAN NO. 3001



DEFLECTION CURVES

Showing TOP of steel stringer on ℄ of roadway before & after jacking up.



DEFLECTION CURVES

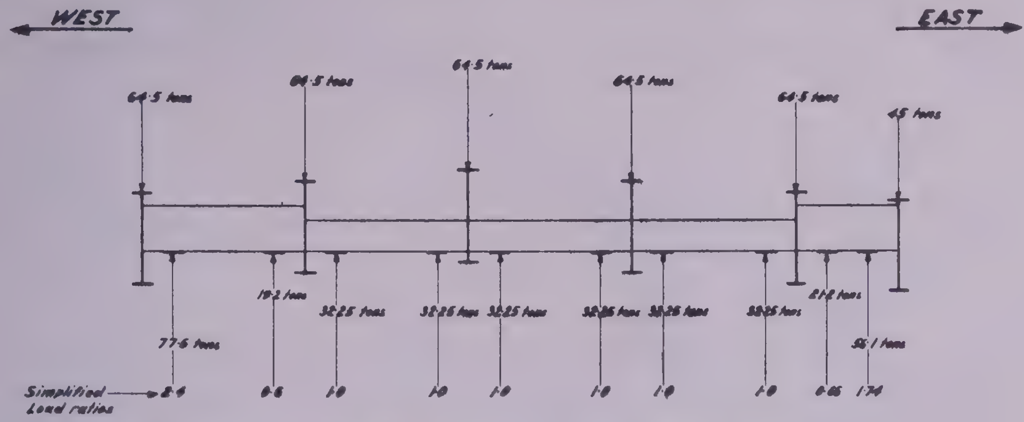
Showing structure @ completion of concrete pours & before lowering to final position.

Scales: — Horiz.

Vert.

NOTE:

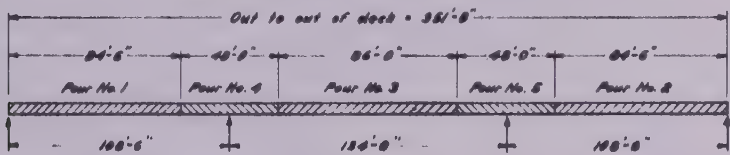
Exact elevations shown at Abutment & Pier. All others are calculated from deflection curves, & are therefore approximate, particularly as no two stringers will follow exactly the same curve. Allowance must be made for crossfall of deck in calculating elevations for other stringers.



ESTIMATED JACKING REACTIONS

After all pours completed & before lowering superstructure.
Not to scale

POURING SCHEDULE



POURS NO. 1 & 2
End spans for full width of deck to a distance of 84'-6" from end of girder. — Volume per pour = 60.18 cu. yds.

POUR NO. 3
Full width of deck for a distance of 43'-0" on each side of transverse ℄ of bridge. — Volume = 63.54 cu. yds.

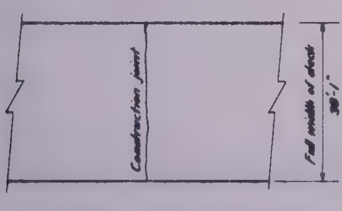
POURS NO. 4 & 5
Full width of deck for a distance of 24'-0" on each side of piers. — Volume per pour = 32.61 cu. yds.

POUR NO. 6
Place precast curb & sidewalk units & pour cast-in-situ blocks. — Volume - precast units = 23.00 cu. yds.
Volume - cast-in-situ blocks = 13.00 cu. yds.

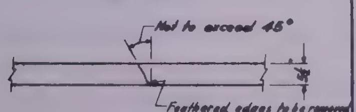
POURS NO. 7 & 8
Approach slabs. — Volume per slab = 16.5 cu. yds.

GENERAL NOTE

Pours must be made in the order designated except that:
Pours No. 1 & 2 may be made simultaneously, or in reverse order, if desired.
Pours No. 4 & 5 may be made simultaneously, or in reverse order, if desired.
Construction joints between pours need not be vertical, but the angle of slope shall not be greater than 45° from the vertical.
Immediately before proceeding with pours No. 4 & 5 the faces of construction joints formed by pours No. 1, 2 & 3 shall be cleaned to the satisfaction of the Engineer & coated with epoxy resin.



PLAN



ELEVATION

DETAIL OF CONSTRUCTION JOINT
Scale: 1"=20'-0"

REVISIONS

DECK DEFLECTION CURVES
FOR 351'-0" STEEL & REINF. CONCRETE BRIDGE
OVER ASSINIBOINE RIVER ON 18TH STREET
30'-0" ROADWAY

CITY OF BRANDON

PROVINCE OF MANITOBA
HIGHWAYS BRANCH BRIDGE ENGINEER'S OFFICE
DEPARTMENT OF PUBLIC WORKS

Designed by C.E.I. Drawn by M.A. Traced by M.A.
Design checked by Drawing checked by KSV
Approved by [signature] BRIDGE ENGINEER [signature] CHIEF ENGINEER
Date February 1961 Sheet No 20/24 Folio No Plate No 36
Scale As shown Plan No 3001

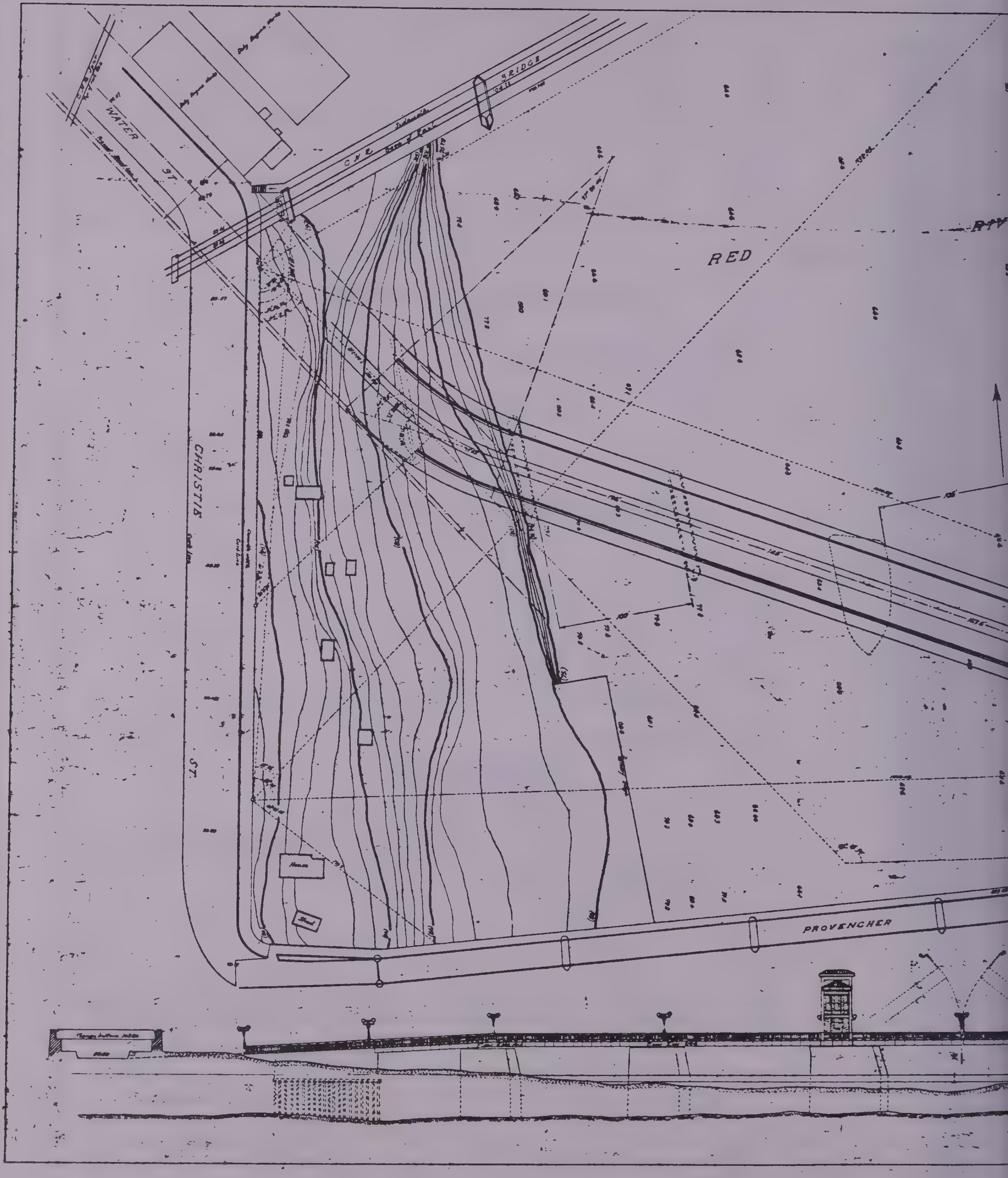
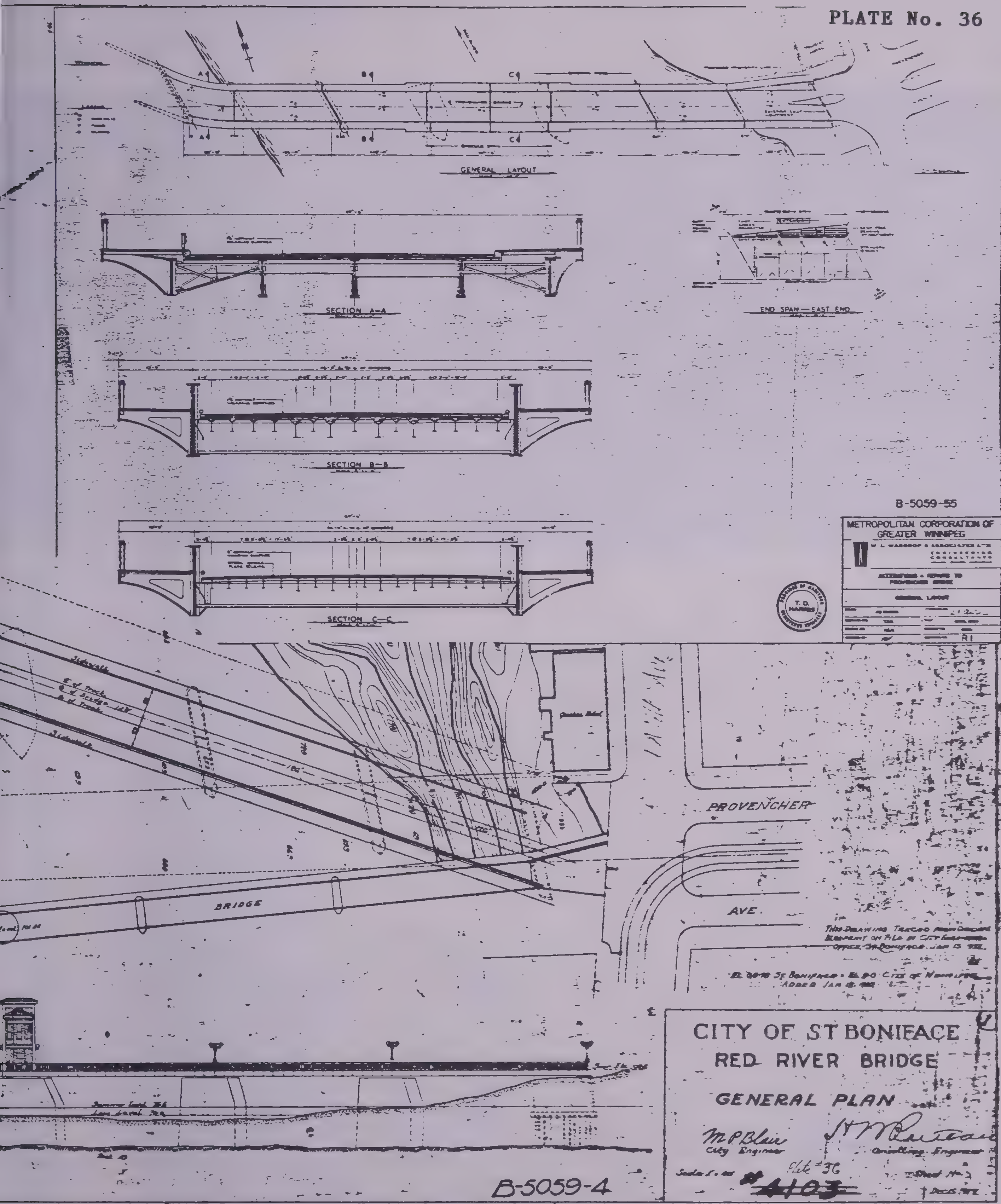

WATER
ST.
C.N.R.
BRIDGE
RED
RIV
CHRISTIE
ST.
PROVENCHER
House

PLATE No. 36



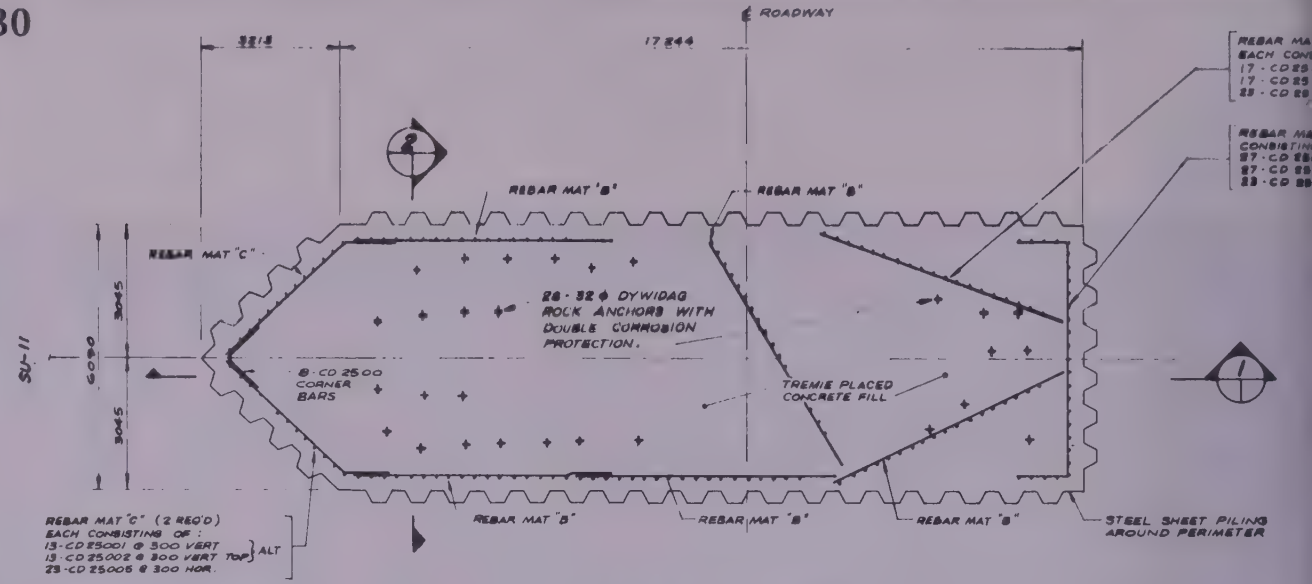
GENERAL LAYOUT
SECTION A—A
END SPAN—EAST END
SECTION B—B
SECTION C—C
B-5059-55
METROPOLITAN CORPORATION OF GREATER WINNIPEG
T. D. HARRIS
R1
PROVENCHER
AVE.
BRIDGE
Sidewalk
CITY OF ST BONIFACE
RED RIVER BRIDGE
GENERAL PLAN
M.P. Blair
City Engineer
Consulting Engineer
Plate #36
4103
B-5059-4

PLATE No. 37(a)

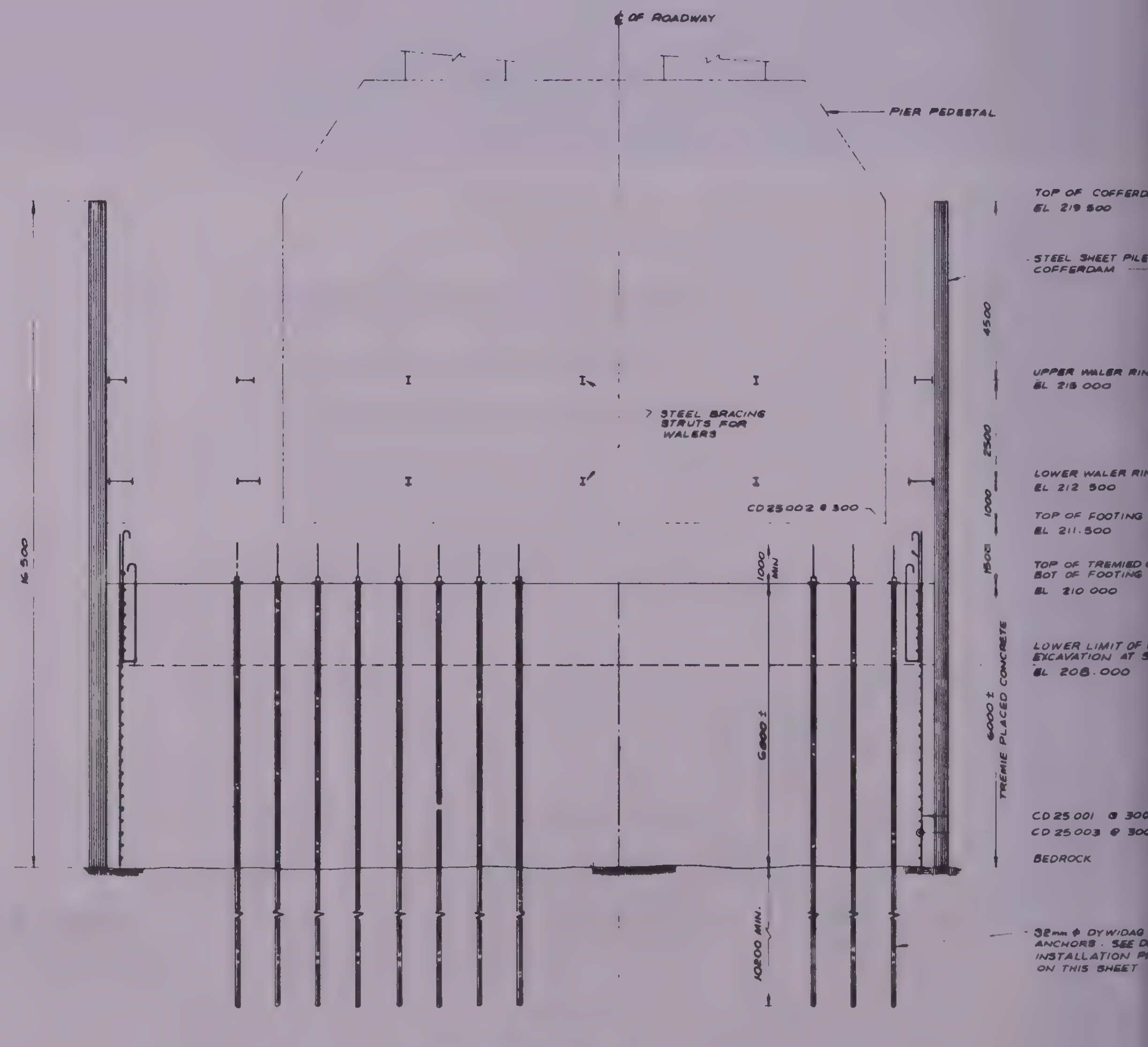
GENERAL ARRANGEMENT
RED RIVER BRIDGE
NORTH OF SELKIRK

PROVINCE OF MANITOBA
28/6/85
N. B.
ULYATT
REGISTERED ENGINEER

DILLON
Consulting Engineers • Planners
Environmental Scientists



PLAN OF COFFERDAM



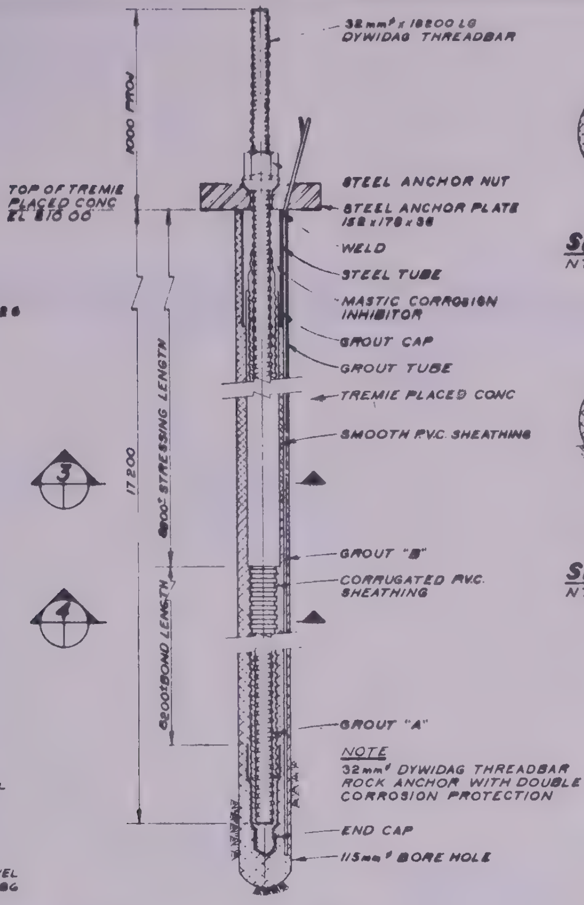
SECTION 1

PLATE No. 37(b)

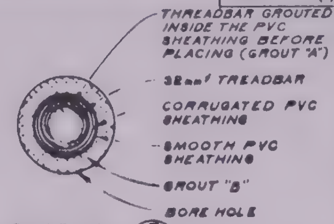
ES

R SHEET PILE COFFERDAM SEE SHEET NO 8

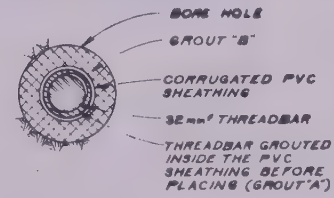
N PIER SU 11 ABOVE EL 810.000 SEE SHEETS NO 85 & 86



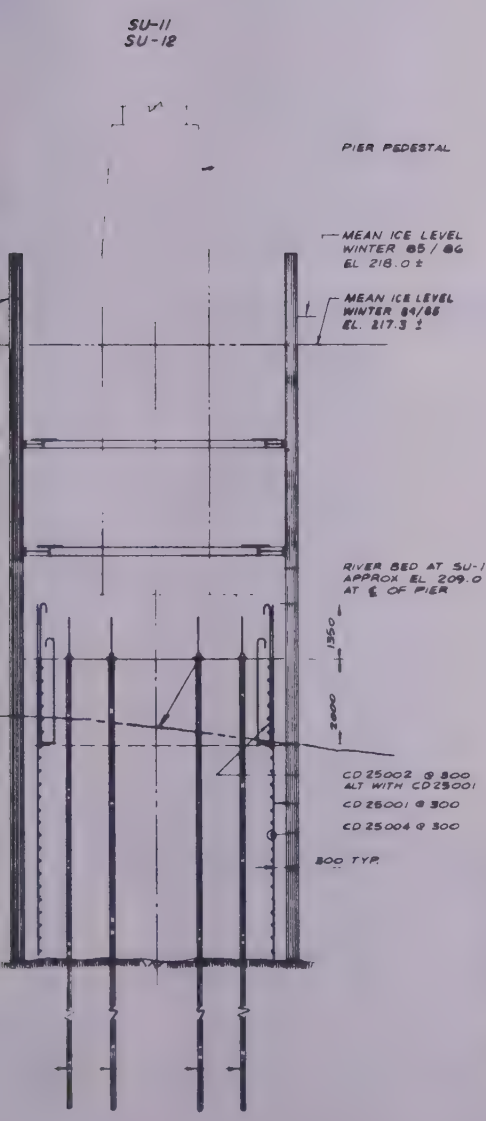
TYPICAL ROCK ANCHOR DETAIL
NTS



SECTION 3
NTS



SECTION 4
NTS



SECTION 2

ROCK ANCHORS–BILL OF MATERIAL

LOCATION	NO REQ'D.	DESCRIPTION	LENGTH OF UNIT	TOTAL LENGTH
SU- 11	28	DYWIDAG ANCHOR UNIT WITH DOUBLE CORROSION PROTECTION	18 200	509 600

ROCK ANCHOR INSTALLATION PROCEDURE

1. DEWATER COFFERDAM & CLEAN SURFACE OF TREMIED CONC
2. BORE 115mm⌀ HOLES THROUGH TREMIED CONC INTO BEDROCK TO EL 192 800
3. GROUT SPACE BETWEEN THREADBAR & CORRUGATED SHEATHING (GROUT "A" - DONE IN FACTORY
4. INSTALL ANCHOR ASSEMBLY IN BORE HOLE
5. GROUT BORE HOLE WITH TYPE 30 CEMENT GROUT (GROUT "B")
6. AFTER GROUT "B" HAS REACHED MANUFACTURES SPECIFIED STRENGTH. TENSION THE THREADBARS AS FOLLOWS:
   i) TEST LOAD TO 300 KN
   ii) REDUCE LOAD TO 125 KN PERMANENT FORCE

AS BUILT
APPROVED BY: [signature]

REVISIONS		
DATE	BY	DESCRIPTION
SEPT 6/85	C.R.B.	BRIDGE LENGTHENED AND SUBSTRUCTURE UNITS RENUMBERED

TREMIE PLACED CONCRETE, REINFORCEMENT AND ROCK ANCHORS IN COFFERDAM AT SU-11

FOR RED RIVER BRIDGE NORTH OF SELKIRK
RIVER LOTS 50,51,203 AND 204 – PARISH OF ST. PETERS
R.M.'S OF ST. ANDREWS AND ST. CLEMENTS

Manitoba Highways and Transportation
Bridge Division

APPROVED BY
DIRECTOR DATE

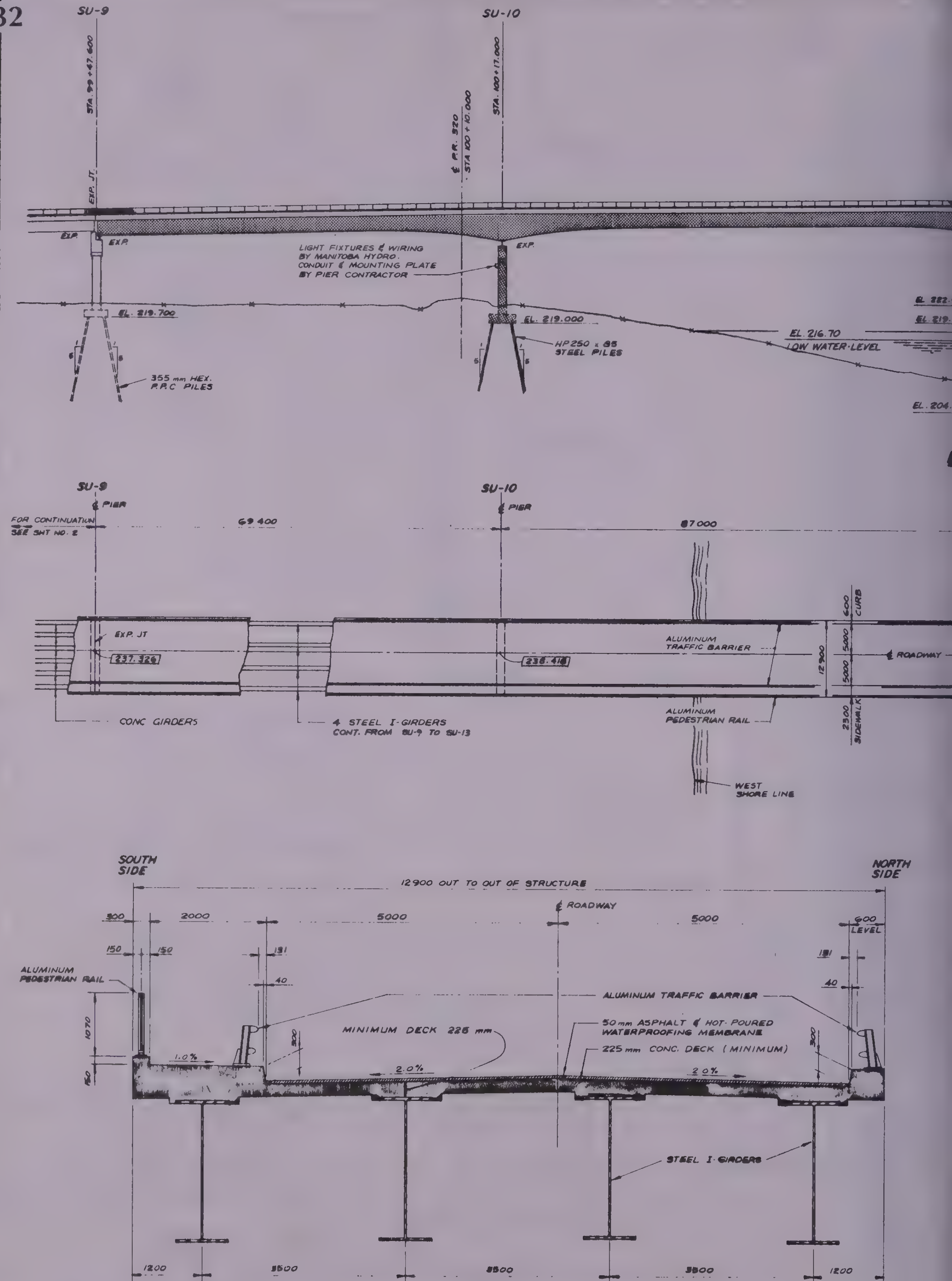
APPROVED BY:
CHIEF BRIDGE ENGINEER DATE

PROJECT ENGINEER		
DESIGN	BY	N.B.U.
	CHECKED	W.I. & S.S.R.
DETAILS	BY	W.P.S.
	TRACED	W.P.S.
	CHECKED	N.B.U.

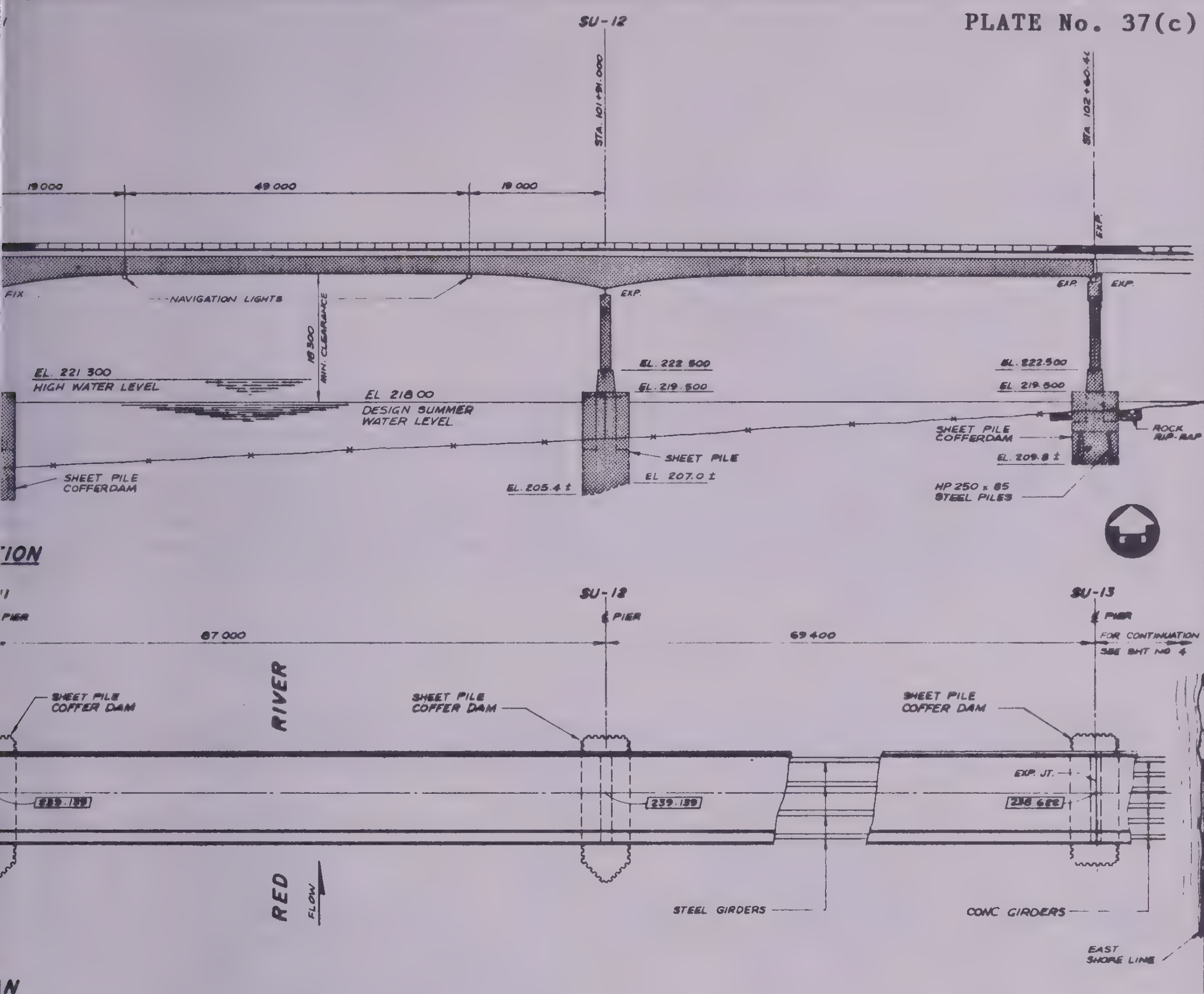
SCALE: 1:75 OR AS NOTED
SHEET No. 24
SITE No. 1662

28/6/85
28/6/85

DILLON
Consulting Engineers & Planners



TYPICAL CROSS SECTION THROUGH STEEL GIRDERS
SCALE 1:40



NOTES

1. LIMITS OF EXCAVATION FOR SUBSTRUCTURE UNIT SU-9 IS SHOWN ON SHEET 21
2. PILING AND FOOTING LAYOUTS FOR SUBSTRUCTURE UNIT SU-9 IS SHOWN ON SHEET 21

SHADING INDICATES STEEL GIRDERS AND PIERS BUILT AND ERECTED UNDER PREVIOUS CONTRACT

AS BUILT
APPROVED BY

REVISIONS		
SEP 6/85	DMW	BRIDGE LENGTHENED & SUB STRUCTURE UNITS RENUMBERED
DATE	BY	DESCRIPTION

GENERAL ARRANGEMENT
RIVER CROSSING SPANS
SU-9 TO SU-13

FOR RED RIVER BRIDGE NORTH OF SELKIRK
RIVER LOTS 50,51,203 AND 204 - PARISH OF ST. PETERS
R.M.'S OF ST. ANDREWS AND ST. CLEMENTS

Manitoba Highways and Transportation
Bridge Division

APPROVED BY
DIRECTOR DATE

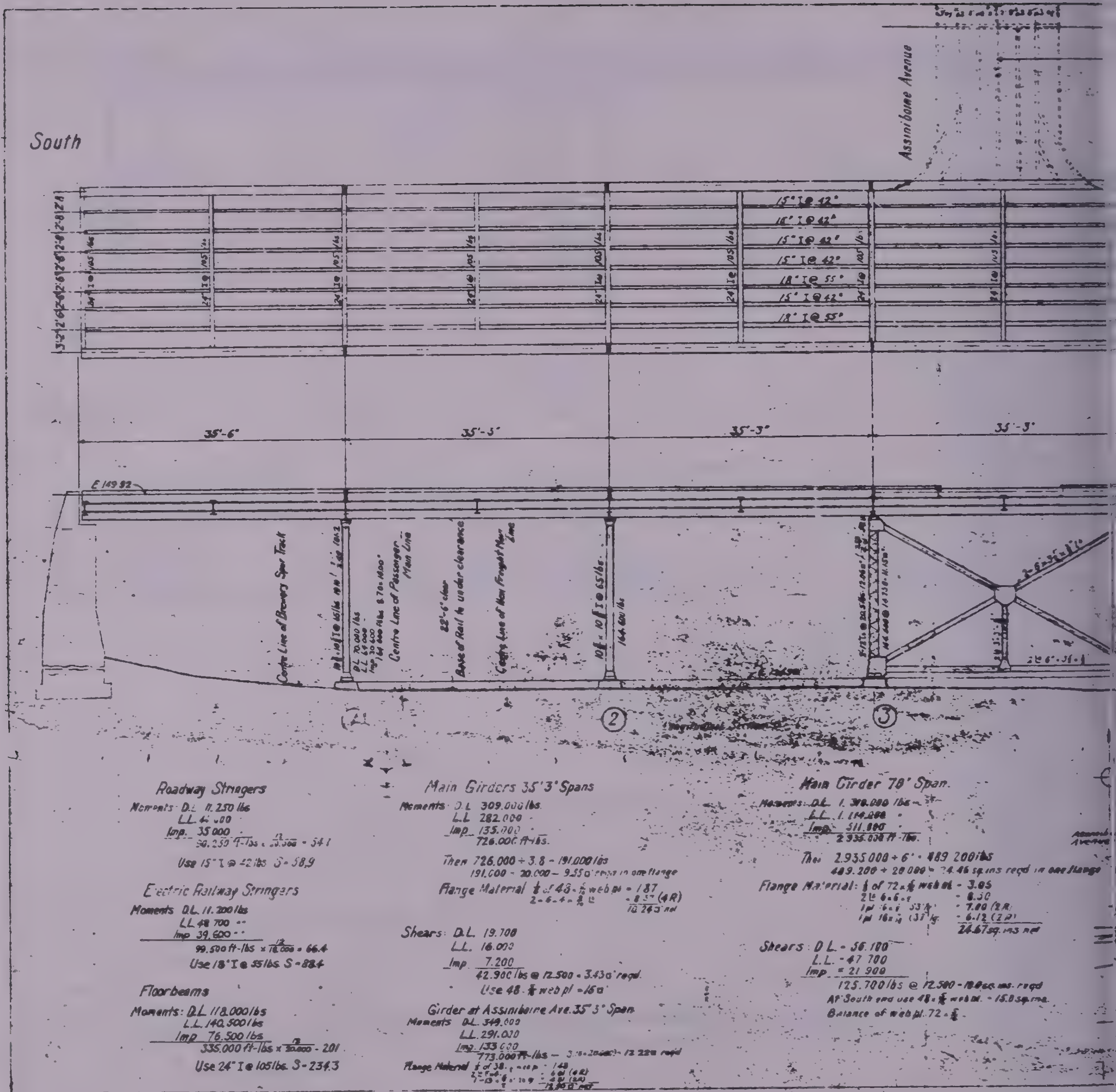
APPROVED BY
CHIEF BRIDGE ENGINEER DATE

PROJECT ENGINEER		
DESIGN	BY	NBU
	CHECKED	SSR
DETAILS	BY	WPS
	TRACED	DMW. & WPS
	CHECKED	NBU

SCALE: 1:400 OR AS NOTED
SHEET No. 3
SITE No. 1362

PROVINCE OF MANITOBA 28/6/85 N.D. ULYATT REGISTERED ENGINEER
PROVINCE OF MANITOBA 28.6.85 S.S. RIHAL REGISTERED ENGINEER

DILLON
Consulting Engineers & Planners



South
Assiniboine Avenue
15" I @ 42"
16" I @ 42"
15" I @ 42"
15" I @ 42"
18" I @ 55"
15" I @ 42"
18" I @ 55"
35'-6"
35'-3"
35'-3"
35'-3"
Centre Line of Brewers Spur Track
Centre Line of Passenger Main Line
Base of Rail to under clearance
Centre Line of New Freight Main Line
10 - 10 I @ 65 lbs.
2
3
Roadway Stringers
Use 15" I @ 42 lbs S = 58.9
Electric Railway Stringers
Moments D.L. 11.200 lbs
LL 48 700
Imp 39.600
99.500 ft-lbs
Use 18" I @ 55 lbs S = 88.4
Floorbeams
Moments: D.L 118.000 lbs
L.L. 140.500 lbs
Imp 76.500 lbs
335.000 ft-lbs - 201
Use 24" I @ 105 lbs. S = 234.3
Main Girders 35'3" Spans
Moments D.L 309.000 lbs.
L.L 282.000
Imp 135.000
726.000 ft-lbs.
Then 726.000 ÷ 3.8 = 191.000 lbs
Flange Material
Shears: D.L. 19.700
L.L. 16.000
Imp 7.200
42.900 lbs @ 12.500 = 3.43 reqd.
Girder at Assiniboine Ave. 35' 3" Span
Moments D.L. 349.000
L.L. 291.000
Imp. 133.000
773.000 ft-lbs
Flange Material
Main Girder 78' Span.
Imp. 511.000
Then 2.935.000 ÷ 6' = 489 200 lbs
Flange Material: 3.05
7.00 (2R)
6.12 (2R)
24.67 sq. ins net
Shears: D L. = 56.100
L.L. = 47 700
Imp. = 21 900
125.700 lbs @ 12.500
Balance of web pl. 72

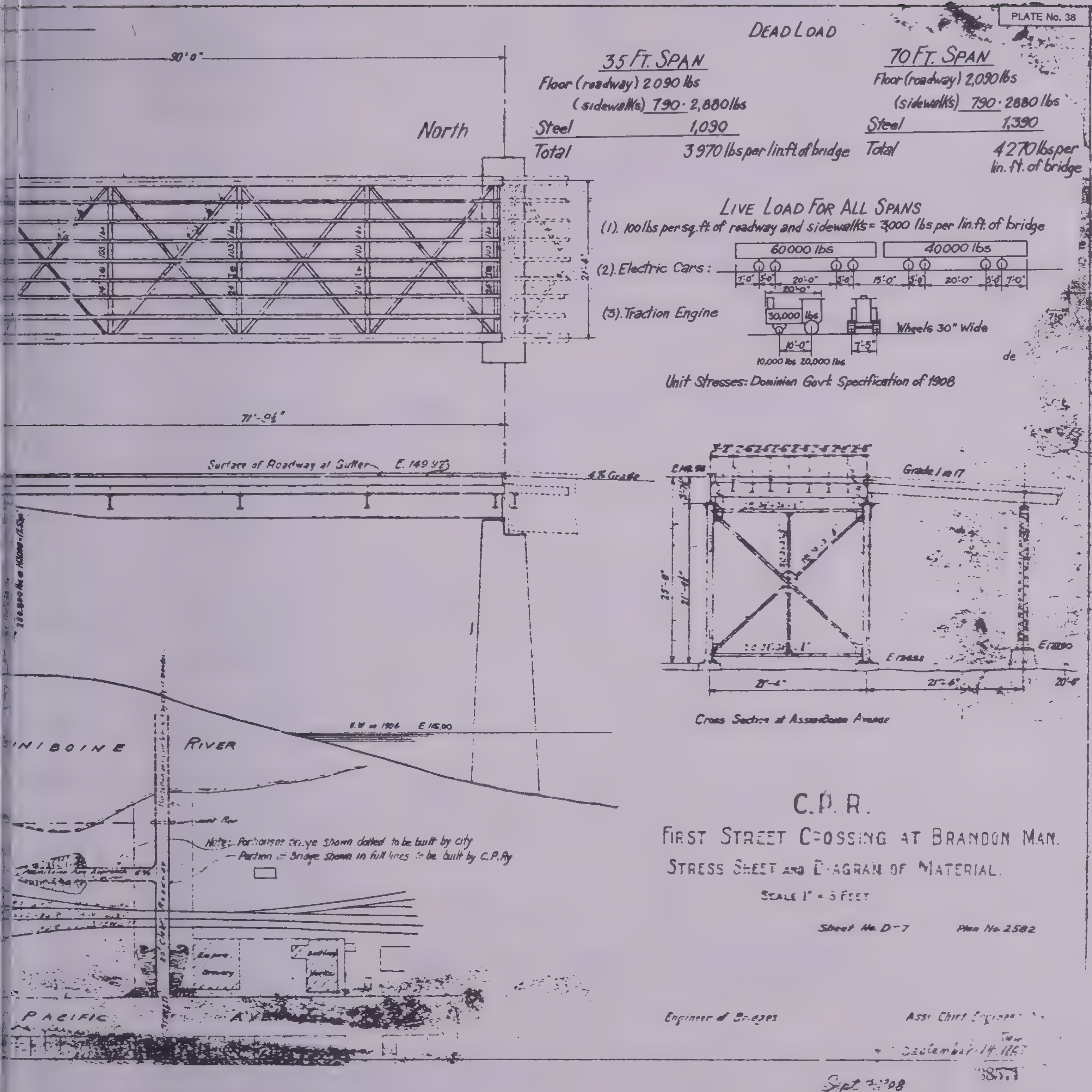
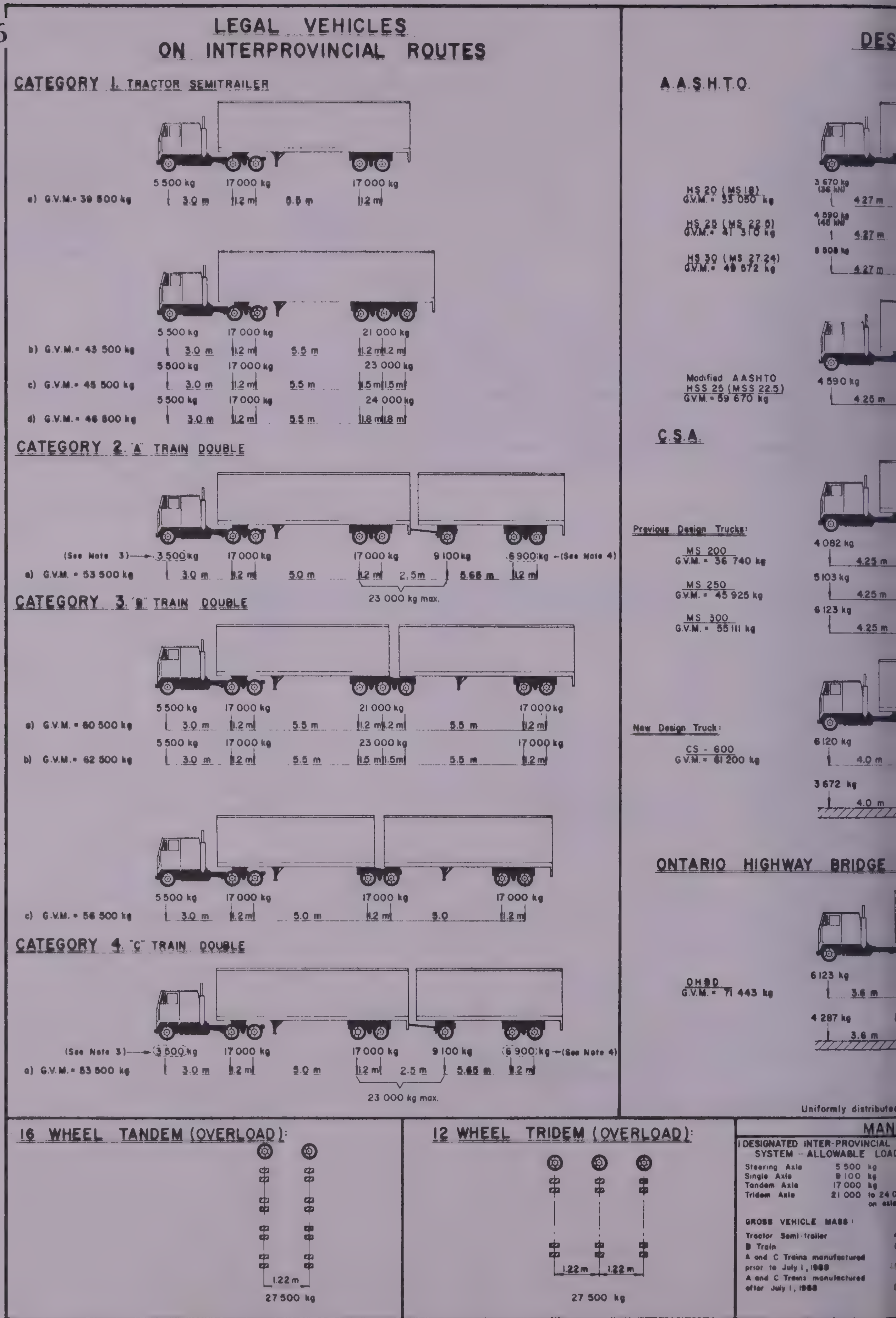
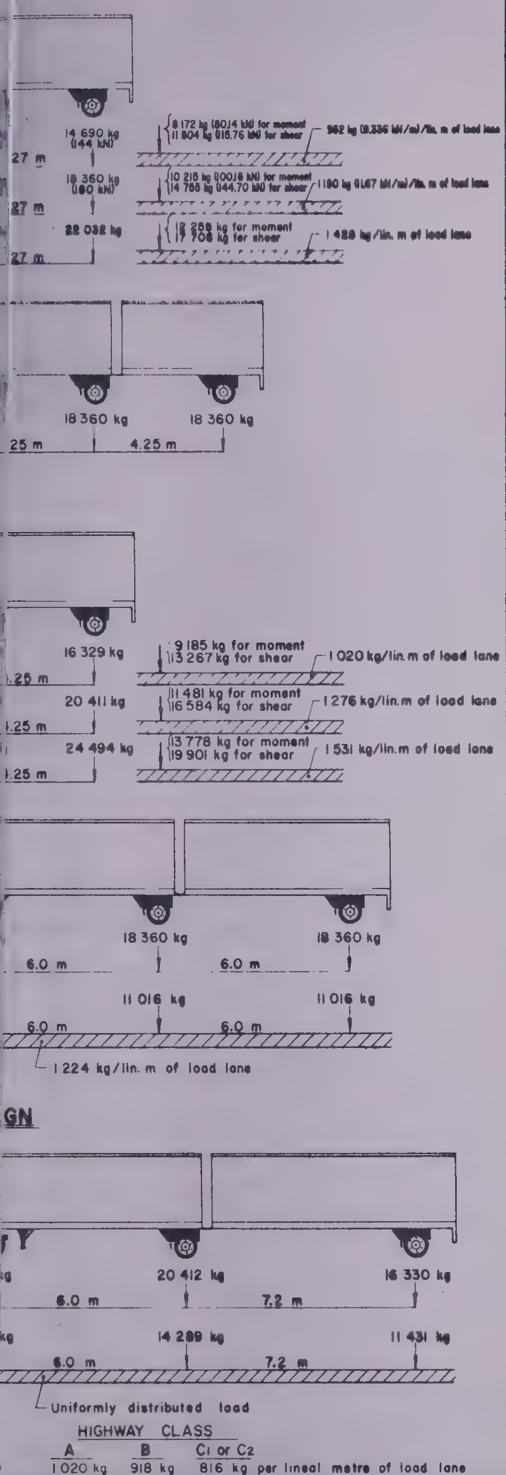


PLATE No. 38
DEAD LOAD
35 FT. SPAN
Floor (roadway) 2090 lbs
(sidewalks) 790 · 2,880 lbs
Steel 1,090
Total 3970 lbs per lin.ft. of bridge
70 FT. SPAN
Floor (roadway) 2,090 lbs
(sidewalks) 790 · 2880 lbs
Steel 1,390
Total 4270 lbs per lin. ft. of bridge
North
LIVE LOAD FOR ALL SPANS
(1). 100 lbs per sq. ft. of roadway and sidewalks = 3000 lbs per lin. ft. of bridge
(2). Electric Cars:
60000 lbs
40000 lbs
(3). Traction Engine
30,000 lbs
10,000 lbs 20,000 lbs
Wheels 30" Wide
Unit Stresses: Dominion Govt. Specification of 1908
Surface of Roadway at Gutter
4% Grade
Grade 1 in 17
Cross Section at Assiniboine Avenue
RIVER
PACIFIC
Note: Portion of Bridge shown dotted to be built by city
Portion of Bridge shown in full lines to be built by C.P.Ry
C.P.R.
FIRST STREET CROSSING AT BRANDON MAN.
STRESS SHEET AND DIAGRAM OF MATERIAL.
SCALE 1" = 5 FEET
Sheet No. D-7
Plan No. 2582
Engineer of Bridges
Asst. Chief Engineer
Sept. 1908


LEGAL VEHICLES
ON INTERPROVINCIAL ROUTES
CATEGORY 1. TRACTOR SEMITRAILER
5 500 kg 17 000 kg 17 000 kg
a) G.V.M. = 39 500 kg 3.0 m 1.2 m 5.5 m 1.2 m
5 500 kg 17 000 kg 21 000 kg
b) G.V.M. = 43 500 kg 3.0 m 1.2 m 5.5 m 1.2 m 1.2 m
5 500 kg 17 000 kg 23 000 kg
c) G.V.M. = 45 500 kg 3.0 m 1.2 m 5.5 m 1.5 m 1.5 m
5 500 kg 17 000 kg 24 000 kg
d) G.V.M. = 46 500 kg 3.0 m 1.2 m 5.5 m 1.8 m 1.8 m
CATEGORY 2. "A" TRAIN DOUBLE
(See Note 3) 3 500 kg 17 000 kg 17 000 kg 9 100 kg 6 900 kg (See Note 4)
a) G.V.M. = 53 500 kg 3.0 m 1.2 m 5.0 m 1.2 m 2.5 m 5.65 m 1.2 m
23 000 kg max.
CATEGORY 3. "B" TRAIN DOUBLE
5 500 kg 17 000 kg 21 000 kg 17 000 kg
a) G.V.M. = 60 500 kg 3.0 m 1.2 m 5.5 m 1.2 m 1.2 m 5.5 m 1.2 m
5 500 kg 17 000 kg 23 000 kg 17 000 kg
b) G.V.M. = 62 500 kg 3.0 m 1.2 m 5.5 m 1.5 m 1.5 m 5.5 m 1.2 m
5 500 kg 17 000 kg 17 000 kg 17 000 kg
c) G.V.M. = 56 500 kg 3.0 m 1.2 m 5.0 m 1.2 m 5.0 1.2 m
CATEGORY 4. "C" TRAIN DOUBLE
(See Note 3) 3 500 kg 17 000 kg 17 000 kg 9 100 kg 6 900 kg (See Note 4)
a) G.V.M. = 53 500 kg 3.0 m 1.2 m 5.0 m 1.2 m 2.5 m 5.65 m 1.2 m
23 000 kg max.
DES
A.A.S.H.T.O.
HS 20 (MS 18) G.V.M. = 35 050 kg
HS 25 (MS 22.5) G.V.M. = 41 310 kg
HS 30 (MS 27.24) G.V.M. = 49 572 kg
3 670 kg (36 kN) 4.27 m
4 590 kg (45 kN) 4.27 m
5 508 kg 4.27 m
Modified AASHTO HSS 25 (MSS 22.5) G.V.M. = 59 670 kg
4 590 kg 4.25 m
C.S.A.
Previous Design Trucks:
MS 200 G.V.M. = 36 740 kg
MS 250 G.V.M. = 45 925 kg
MS 300 G.V.M. = 55 111 kg
4 082 kg 4.25 m
5 103 kg 4.25 m
6 123 kg 4.25 m
New Design Truck:
CS - 600 G.V.M. = 61 200 kg
6 120 kg 4.0 m
3 672 kg 4.0 m
ONTARIO HIGHWAY BRIDGE
OHBD G.V.M. = 71 443 kg
6 123 kg 3.6 m
4 287 kg 3.6 m
Uniformly distributed
16 WHEEL TANDEM (OVERLOAD):
1.22 m
27 500 kg
12 WHEEL TRIDEM (OVERLOAD):
1.22 m 1.22 m
27 500 kg
MAN
DESIGNATED INTER-PROVINCIAL SYSTEM - ALLOWABLE LOAD
Steering Axle 5 500 kg
Single Axle 9 100 kg
Tandem Axle 17 000 kg
Tridem Axle 21 000 to 24 0
GROSS VEHICLE MASS:
Tractor Semi-trailer
B Train
A and C Trains manufactured prior to July 1, 1988
A and C Trains manufactured after July 1, 1988

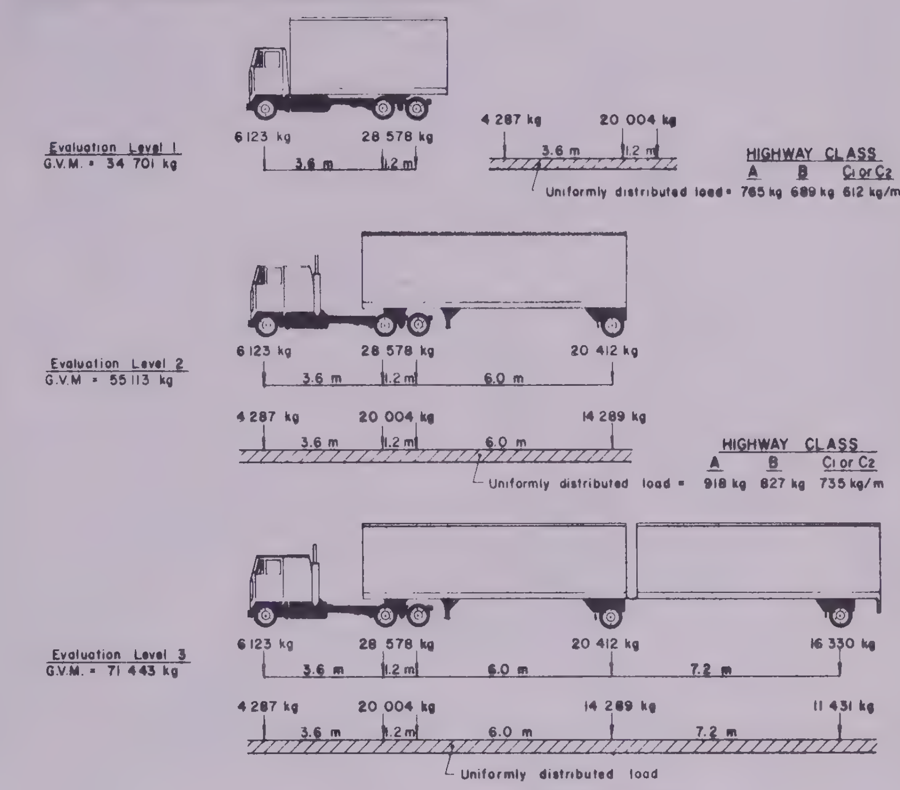
VEHICLES



RATING/OVERLOAD VEHICLES

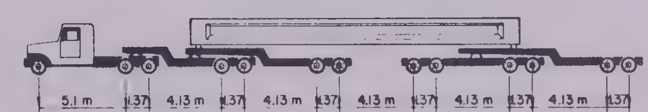
PLATE No. 39

ONTARIO HIGHWAY BRIDGE DESIGN



	HIGHWAY CLASS		
	A	B	C1 or C2
Uniformly distributed load =	1 020 kg	918 kg	816 kg per lineal metre of load lane

CALIFORNIA CONFIGURATION



G.V.M. = 55 400 kg	11 800 kg	21 800 kg	21 800 kg				
G.V.M. = 77 200 kg	11 800 kg	21 800 kg	21 800 kg	21 800 kg			
G.V.M. = 99 000 kg	11 800 kg	21 800 kg	21 800 kg	21 800 kg	21 800 kg		
G.V.M. = 120 800 kg	11 800 kg	21 800 kg	21 800 kg	21 800 kg	21 800 kg	21 800 kg	
G.V.M. = 142 600 kg	11 800 kg	21 800 kg	21 800 kg	21 800 kg	21 800 kg	21 800 kg	21 800 kg

NOTES:

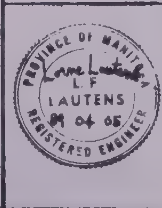
1. GVM. = Gross Vehicle Mass.
2. Mass units are used so that actual legal vehicles can be compared to theoretical design vehicles.
3. Steering axle may be increased from 3 500 kg to 5 500 kg if load is reduced elsewhere by 2 000 kg.
4. Rear axle load may be increased if load is reduced elsewhere by an equivalent amount. Maximum sum of axle loads on second trailer. = 16 000 kg.
5. Conversion Factor: 1 kg = 0.009807 kN = 2.204 lbs.
   1 m = 3.2808 ft.

A'S LEGAL TRUCK LOADS

Y	2. REMAINDER OF PROVINCIAL TRUNK HIGHWAY SYSTEM – ALLOWABLE LOADS		3. PROVINCIAL ROAD SYSTEM ALLOWABLE LOADS	
	Steering Axle	5 500 kg	Steering Axle	5 500 kg
	Single Axle	9 100 kg	Single Axle	8 200 kg
	Tandem Axle	16 000 kg	Tandem Axle	14 500 kg
pending	Tridem Axle	23 000 kg, depending on axle spread	Tridem Axle	20 000 kg
	GROSS VEHICLE MASS:		GROSS VEHICLE MASS:	
kg	Tractor Semi trailer	44 500 kg	Tractor Semi-trailer	40 000 kg
kg	B-Train	56 500 kg	B-Train	47 630 kg
	A and C Trains manufactured		A and C Trains	47 630 kg
kg	prior to July 1, 1988	56 500 kg		
	A and C Trains manufactured			
kg	after July 1, 1988	53 500 kg		

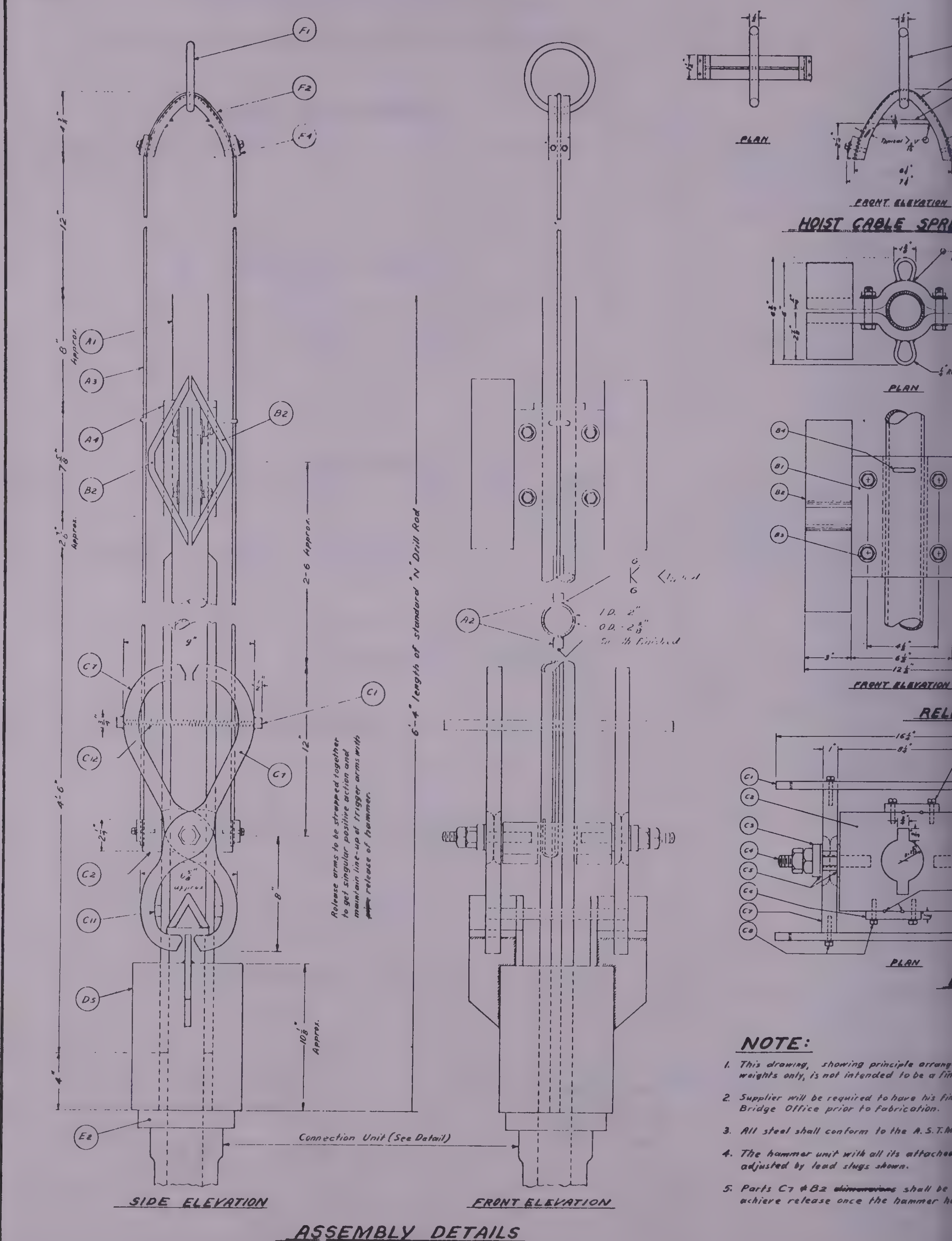
TRUCK CONFIGURATIONS

(FOR INFORMATION PURPOSES ONLY)



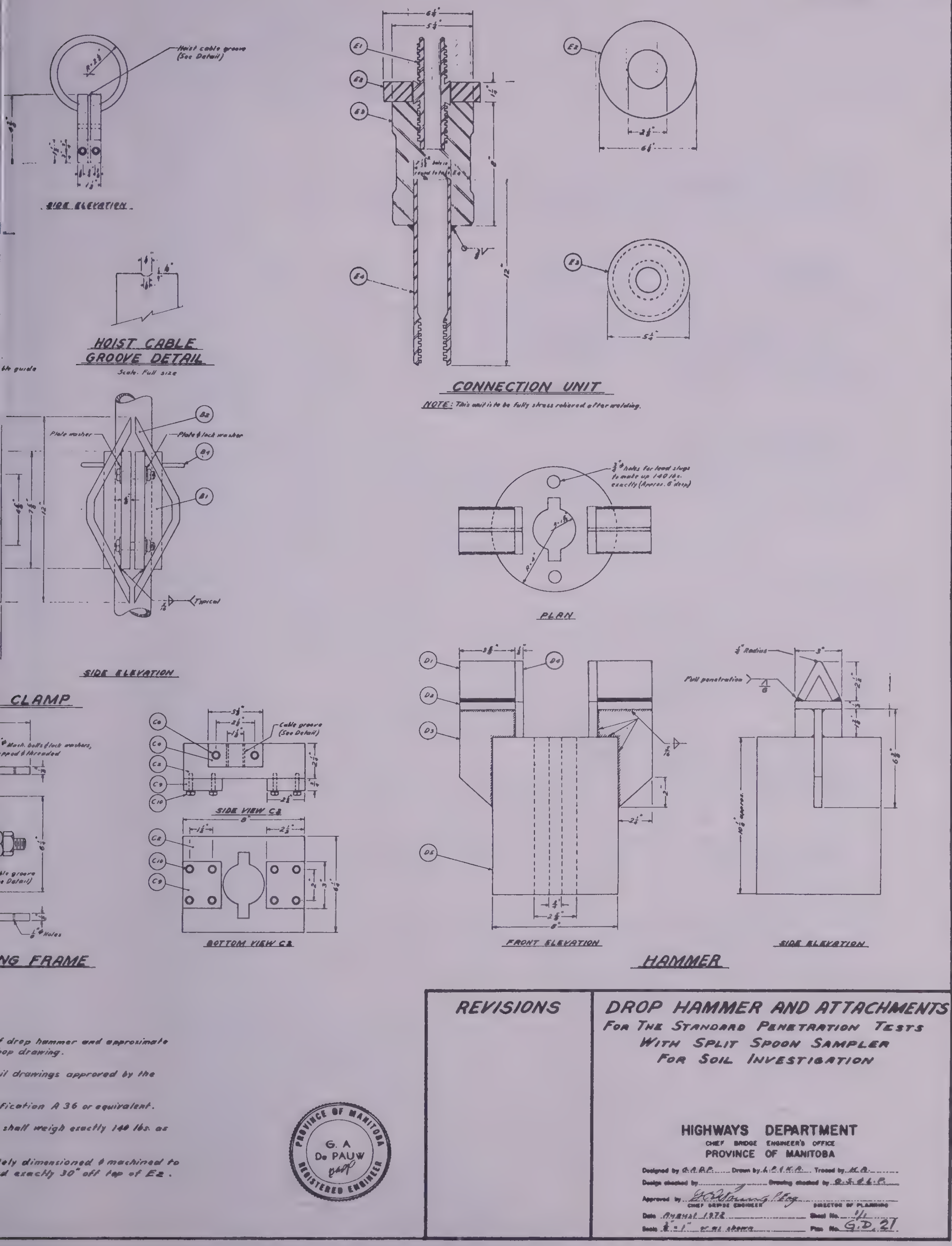
Manitoba Highways and Transportation
Bridge Division

APPROVED BY		
EXECUTIVE DIRECTOR	DATE	
PROJECT ENGINEER		APPROVED BY
DESIGN	BY: L.F.L.	DIRECTOR OF BRIDGES — DATE
	CHECKED:	
DETAILS	BY: R.W.	SCALE: Not to scale
	TRACED: NN	SHEET No. 1/1
	CHECKED:	SITE No. N.A.



ASSEMBLY DETAILS

Scale: 3" = 1'-0"


Hoist cable groove (See Detail)
SIDE ELEVATION
HOIST CABLE GROOVE DETAIL
Scale: Full size
CONNECTION UNIT
NOTE: This unit is to be fully stress relieved after welding.
Plate washer
Plate & lock washer
Typical
SIDE ELEVATION
CLAMP
Cable groove (See Detail)
SIDE VIEW C2
BOTTOM VIEW C2
NG FRAME
PLAN
Full penetration
FRONT ELEVATION
SIDE ELEVATION
HAMMER
f drop hammer and approximate
op drawing.
il drawings approved by the
fication A 36 or equivalent.
shall weigh exactly 140 lbs. as
ely dimensioned & machined to
d exactly 30" off top of E2.
PROVINCE OF MANITOBA
G. A De PAUW
REGISTERED ENGINEER
REVISIONS
DROP HAMMER AND ATTACHMENTS
FOR THE STANDARD PENETRATION TESTS
WITH SPLIT SPOON SAMPLER
FOR SOIL INVESTIGATION
HIGHWAYS DEPARTMENT
CHIEF BRIDGE ENGINEER'S OFFICE
PROVINCE OF MANITOBA
Date August 1972
Plan No. G.D. 27

List of Figures

List of Tables

Appendices

1. A partial copy of "An Act to Incorporate the Association of Professional Engineers of the Province of Manitoba" (APEM) and the listing of the Officers and Members of the APEM in 1920-1921. **242**

2. (a) Copy of a "Report of a Committee of the Executive Council, approved by His Honour the Lieutenant Governor, May, 1916". **246**
   (b) A listing of "Good Roads Engineering Staff" showing salaries now being paid and changes recommended, Feb. 23, 1925. **247**
   (c) Copy of a letter from the "ACTING CIVIL SERVICE COMMISSIONER" to the Hon. W. R. Clubb, Minister of Public Works dated December 22nd., 1928." **248.**

3. Coast Testing Laboratories Limited, Inspection and Testing Engineers-Report of Treatment and Inspection of Creosoted Douglas Fir Lumber (For the Fisher River Bridge). Site No. 2474, Plate No. 17. **249.**

4. Sanford Evans Building News, October 12, 1935. **250**

5. Fig. 2 - General Drawing of the Lift Span of the Selkirk Bridge taken from an article on the "New Highway Bridge Over the Red River at Selkirk, Manitoba" by H. M. White, Chief Engineer, Dominion Bridge, in January 12, 1937 issue of "The Canadian Engineer". **251**

6. A copy of 1962 - Brokenhead River, Plan No. 3239 - Cost Analysis of the Precast Prestressed Concrete Bridge. **252**

7. Graphs taken from the "Pile Load Test Report" on a steel H-pile at Site No. 4 showing the following:
   (a) Load vs. Settlement Curve **253**
   (b) Settlement vs. Time Curves **254**
   (c) Pile Penetration vs. Blows/ft **255**

8. A "Cost Comparison Summary" between a Prestressed Precast Concrete alternative and a Steel Girder alternative for the Red River Floodway Bridge on P.T.H. No. 4 (now P.T.H. No. 44 East), Site No. 4. **256**

9. Specification for Concrete Topping on New Surfaces, June, 1967, Spec. 1036. **257**

10. APEM's Code of Ethics adopted Nov. 1, 1921. **259**

An Act to Incorporate

The Association of Professional Engineers of the Province of Manitoba

CHAPTER 38

An Act respecting the Engineering Profession

[Assented to March 27th, 1920]

HIS MAJESTY, by and with the advice and consent of the Legislative Assembly of Manitoba, enacts as follows:

1. This Act may be cited as "The Engineering Profession Act."

INTERPRETATION

2. In this Act unless the context otherwise requires, the expression:

Professional Engineer

(a) "professional engineer" means any person registered as a professional engineer under the provisions of this Act;

Practice of

(b) "Professional engineering" or "the practice of a professional engineer" embraces the designing, supervision, the advising on the design or supervision and the advising on the making of measurements for the construction, enlargement, alteration, improvement, maintenance or valuation of public or private utilities, industrial work, railways, bridges, tunnels, highways, roads, canals, harbour works, harbours, river improvements, lighthouses, wet docks, dry docks, floating docks, dredges, cranes, and other similar work, steam engines, turbines, pumps, internal combustion engines, and other similar mechanical structures, air ships and aeroplanes, electrical machinery and apparatus, chemical and metallurgical machinery, and works

for the development, transmission, or application of power, mining operations and apparatus for carrying out such operations, municipal works, irrigation works, water works, water purification plants, sewerage works, sewage disposal works, drainage works, incinerators, hydraulic works, and all other engineering works. Provided that the execution by a contractor or his assistants of work designed by a professional engineer, or the direction of work as otherwise defined in this clause by superintendent of construction, or superintendent of maintenance, or their subordinates when working from designs or upon advice of a professional engineer, shall not be deemed to be the practice of professional engineering within the meaning of this Act;

Association

(c) "association" means the association of professional engineers of the Province of Manitoba;

Council

(d) "council" means the executive council of the association;

President

(e) "president" means the president of the association;

Registrar

(f) "registrar" means the registrar of the association;

Secretary

(g) "secretary" means the secretary-treasurer of the association;

Board

(h) "board" means the board of examiners of the association.

Association a Corporate Body

3. (1) All persons registered as professional engineers under the provisions of this Act shall constitute the Association of Professional Engineers of the Province of Manitoba, and shall be a body politic and corporate, with perpetual succession and common seal.

Head Office

(2) The head office of the association shall be at Winnipeg.

May Hold Lands

4. The association shall have power to acquire and hold real estate not producing at any time an annual income in excess of ten thousand dollars, and to alienate, mortgage, lease or otherwise charge or dispose of such real estate or any part thereof as occasion may require; and all fees, fines and penalties receivable and recoverable under this Act shall belong to the association.

Pass By-laws

5. The association may pass by-laws not inconsistent with the provisions of this Act for:

(a) the government, discipline and honour of the members;

(b) the management of its property;

(c) the maintenance of the association by levying fees not in excess of five dollars per annum;

(d) the examination and admission of candidates to the study and practice of the profession;

(e) all other purposes reasonably necessary for the management of the association.

Officers of the Association of Professional Engineers of the Province of Manitoba

Provisional Council:
W. M. Scott, President

Councillors:
J. G. LeGrand, J. M. Leamy,
Guy C. Dunn, W. J. Dick,
W. P. Brereton.
G. L. Guy, Secretary-Treasurer and Registrar.

Permanent Council, 1920
M. A. Lyons, President.
J. G. LeGrand, Vice-President
P. Burke-Gaffney, W. P. Breretou
D. A. Ross, A. W. Smith
G. L. Guy, Secretary-Treasurer and Registrar,

Permanent Council, 1921
M. A. Lyons, President.
J. G. LeGrand, Vice-President.
P. Burke-Gaffney, H. A. Dixon,
W. M. Scott, D. A. Ross.
G. L. Guy, Secretary-Treasurer and Registrar.

Board of Examiners
E. P. Fetherstonhaugh, Chairman.
J. N. Finlayson, J. Rocchetti,
J. G. Sullivan, V. J. Melsted.

University Committee
J. G. Sullivan, J. A. Hesketh,
W. M. Scott.

Publicity Committee
P. Burke-Gaffney.

Name	Address	App. No.	Cert. No.
Affleck, G.	209 Oakwood Ave. City	78	94
Agnew, C. W.	c-o Dom. Bridge Co. City	171	......
Aldridge, W.	333 McGee St. City	180	91
Attwood, C. H.	231 Chbr. of Com. City	33	33
Bagshawe, F. T.	91 Inskter Bv. City	230	138
Baldcock, J. W.	224 21st St., Brandon	77	106
Battershill, J. W.	Box 15, E. Kildonan	49	49
Barker, A. W.	183 Lenore St., City	118	67
Berg, H. E.	262 Patterson St., Norwood, Man.	192	160
Blanchard, C. H.	Garson Quarries P. O., Man.	150	111
Blake, H. P.	363 Wardlaw Ave., City	199	
Bowman, H. A.	Dept. of Pub. Works, Par. Bldgs., City	30	30
Bowen, H. B.	959 McMillan Ave., City	161	
Brereton, L. R.	c-o H. Hoodspith, R.R. No. 1, City	16	16
Brereton, W. P.	223 James Ave., City	39	39
Briercliffe, H. C. D.	512 Greenwood Pl., City	144	90
Bright, D. M.	Ste. 17 Hecla Blk, Toronto St., City	130	165
Brockwell, H. E.	105 Norquay St., City	158	50
Brown, G. J.	Ste. 3, 634 Bdway. City	62	35
Brydone-Jack, E. E.	705 Notre Dame Invest. Bldg., City	9	9
Buckingham, E. J.	21 Parkholm Apts., City	235	127

Name	Address	App. No.	Cert. No.
Buerk, J. E.	Carter-Halls-Aldinger Co., City	220	186
Burbidge, G. H.	113 Chestnut St., City	5	5
Burke-Gaffney, P. O'D.	340 Linwood St., St. James, Man.	160	89
Burns, W.	732 McMillan Ave., City	25	25
Cameron, C. F.	Eng. Bldg., Sherbrooke and Portage, City	153	152
Cameron, H. S.	175 Harbison Ave., Elmwood	138	133
Campbell, J. M.	479 Dominion St., City	203	101
Campbell, T. B.	288 Bdway Ave. City	8	166
Cantell, M. T.	707 Union Trust Bldg., City	148	121
Carter, Hugh C.	C.P.R. Eng's. Dept., City	178	65
Caton, E. V.	54 King St., City	6	6
Cavanagh, A. L.	City Eng's. Dept., King and James, City	66	167
Childerhose, E. A.	591 Alverstone St., City	151	......
Clarke, T. W.	P.O. Box 15, Gladstone, Man.	123	163
Clendening, C. A.	54 King St., City	126	93
Connell, A. G.	647 Sherbrooke St., City	80	84
Cooper, R. H.	P.O. Box 273, City	13	13
Copeland, Louis B.	Dept. Pub. Works Par. Bldgs., City	207	102
Corbett, A. H.	507 Camden Pl., City	226	189
Corley, F. S.	219 Rideau St., Brandon, Man.	221	185
Cormick, J. H.	Can. Nat. Rys., City	45	61
Cowan, E. C.	707 McMillan Ave. City	195	98
Davidson, J. McN.	889 Corydon Ave., City	56	55
Davies, F. deC.	705 Notre Dame Inv. Bldg., City	88	122

Name	Address	App. No.	Cert. No.
Davis, W. R.	130 Inkster Ave., City	167	59
Davis, J. C.	52 La Varendrye St., St. Boniface, Man.	71	......
Davison, J. E.	191 Chestnut St., City	142	169
Deacon, T. R.	Man. Bridge and Iron Works, City	185	78
Dillabough, J. V.	136 Eugenie St., Norwood	173	51
Dines, W. W.	223 James St., City	55	36
Dixon, H. A.	Can. Nat. Rys. City	200	108
Douglas, J. A.	Can. Pac. Ry. Co., City	95	136
Ducker, W. A.	Ste. 34-b, Riverview Mansions, City	76	83
Dunn, G. C. B.	Office Chief Eng., C.N.R., Toronto, Ont.	27	27
Easton, L. I.	Bridge Eng. C.N.R. City	70	157
Edwards, H.	288 Bdway., City	179	120
Ferguson, A. D.	Elm Creek, Man.	156	......
Fetherstonhaugh, E. P.	Eng's. Dept. Univ. of Man., City	3	3
Findlay, A.	P.O. Box 83, Portage la Prairie, Man.	67	43
Finlayson, J. N.	243 Elm St., City	53	104
Flint, C.	946 McMillan Ave., City	246	196
Forsyth, J.	Carter-Halls-Aldinger Co., City	20	20
Fosness, A. W.	515 Union Bnk. Bldg., City	210	103
Fowler, F. S.	505 Elec. Ry. Chbrs., City	157	48
Fox, C. H.	Ass't Dis. Eng. C.P.R., City	114	86
Fulton, W.	162 Edmonton St., City	75	154
Fuller, H. P.	178 Roseberry St., St. James, Man.	125	175
Garroni, M. C.	139 Smith St., City	91	117
Gemmel, H. W. R.	Miniota, Man.	90	76
Gordon, J.	Mech. Ser. Dept., C.N.R. City	176	

Name	Address	App. No.	Cert. No.
Gray, C. F.	492 Grt. West Per. Bldg., City	100	124
Guy, G. L.	503 Tribune Bldg., City	169	63
Hagarty, Bertrand.	125 Hargrave St., City	58	73
Hall, N. McL.	Univ. of Man.	14	14
Harrison, G.	460 Union Sta., City	21	21
Harrison, N. F.	199 Horace St., Norwood, Man.	233	193
Harper, R. D.	Sanford, Man.	102	......
Haven, F. G.	Humboldt, Sask.	219	146
Hazel, F. B.	476 St. Mary's Ave., City	107	71
Hazlewood, R. A.	The Pas, Man.	238	129
Henderson, H. B.	407 Boyd Bldg., City	89	66
Herriott, G. H.	94 Walnut St., City	132	81
Hesketh, J. A.	Eng's. Dept. C.P.R., City	59	41
Hill, E. M. McC.	Eng's. Dept. C. N.R., City	57	95
Hill, G. R.	Box 283, Virden, Man.	202	153
Hobbs, W. E.	E. Kildonan, R.R. No. 4, Winnipeg	34	34
Holden, J. C.	111 Gerard St., City	182	204
Holmgren, E. L.	418 Sinclair St., City	83	87
Hunt, W. H.	Good Rds. Eng., Selkirk, Man.	177	88
Irving, G. F.	137 Campbell St., City	166	172
Irving, J. C.	Deloraine, Man.	241	191
James, W. A.	6-a Pasadena Crt., City	24	24
Johnston, B. A.	Good Rds. Bd., Par. Bldgs., City	43	107
Johnston, L.	632 Sherbrooke St., City	110	159
Johnstone, L. I.	Eng. Bldg., cor. Portage and Sherbrooke, City	110	......
Johnson, E. N.	Ste. A, Sec. 3, Fort Garry Crt., City	98	201
Junkins, S. E.	Rm. N., Royal Alex. Hotel, City	208	141

34

Name	Address	App. No.	Cert. No.
Kent, E. S.	321 Overdale Ave., St. James	127	..
Kipp, T. J.	1054 Grosvenor Ave., City	198	99
Kirby, Thos. H.	107 Spence St, City	184	176
Lamont, A. W.	c-o Can. Westinghouse Co., City	12	12
Landon, C. S.	254 Winchester St., St. James, Man.	174	70
Lawrence, John B.	701 Elec. Ry. Chbrs., City	168	72
Leamy, J. M.	Power Com., Par. Bldg. City	40	40
Ledger, G. N.	393 Burrows Ave., City	84	131
Lee, F.	C.P.R., City	92	151
Lee, J.	44 Hargrave St., City	119	113
Lees, T.	297 Aubrey St., City	139	173
Legge, A. H.	460 Union Sta., City	214	145
LeGrand, J. G.	Bridge Eng., C.N.R., City	10	10
Lester, J. F.	P.O. Box 1094, City	183	53
Lester, L. W.	589 Jessie Ave., City	37	37
Lewis, W. A.	274 Berrydale Ave., St. Vital, Man.	159	181
Lloyd, F. L.	55 Isabel St., City	243	195
Lloyd, H.	333 Boyd Ave., City	51	203
Lorimer, H.	176 Aubrey St., City	237	130
Lount, C. T.	501 Union Bk. Bldg. City	122	......
Lowman, C. W.	Portage la Prairie, Man.	225	188
Lyons, M. A.	322 Linwood Ave., St. James, Man.	128	118
Lys, C. R.	19 Muskoka Apts., Young St., City	85	68
Mackenzie, W. D.	155 Harvard Ave., City	54	54
Mason, F. B.	377 Furby St., City	187	82
Matthews, F. E.	261 Langside St., City	117	128
Mawhinney, D. M.	Stonewall, Man.	7	7
Mawhinney, W. G.	Selkirk, Man.	74	75

35

Name	Address	App. No.	Cert. No.
Meindl, J. A.	St. Boniface, Man.	213	144
Melsted, V. J.	508 Paris Bldg., City	81	126
McColl, G. G.	339 Somerset Bldg., City	1	1
McColl, S. E.	339 Somerset Bldg., City	2	2
McGibbon, W. S.	Transcona, Man.	217	182
McGillivray, A.	216 Carlton St., City	129	57
McGillivray, J. A.	Pt. du Bois, Man.	47	47
McKenzie, Bertram S.	806 Union Trust Bldg., City	11	11
McKinnon, R. W.	Ste. N, Amulet Apts., Westminster Ave., City	134	69
McLean, D. L.	701 McMillian Ave., City	234	140
MacLean, F. A. W.	377 Oakwood Ave. City	106	85
Mackay, H. A.	325 Overdale Ave., Deer Lodge, City	60	178
MacTaggart, N. B.	815 Jessie Ave., City	97	109
McLeod, H. W.	C.P.R., City	115	150
Michie, V.	120 Emily St., City	249	199
Moffatt, R. W.	Dept Civil Engs., Univ. of Man., City	26	26
Morse, G. P.	91 Dubuc St., Norwood	4	4
Morris, A. J.	Eng. Dept. C.N.R., City	72	179
Morse, E. H.	208 Hill St., Norwood, Man.	81	126
Morrison, D.	122 Woodhaven Road, Sturgeon Creek, Man.	229	148
Mullins, P. W.	Selkirk, Man.	244	194
Murphy, James	8 Kingston Row, St. Vital, Man.	190	......
Oldham, W. F.	146 Lansdowne Ave., Norwood	73	105
Parker, B. W.	708 Dorchester Ave., City	212	143
Pearson, G. P.	Clandeboye, Man.	222	147
Pearson, F. W.	Wawanesa, Man.	205	202

36

Name			
Pender, W. D.	173 Florence Ave., City	239	162
Philipps, J. B.	18 Spadina Crt., St. Mary's Ave., City	113	115
Polson, A. V.	94 Cathedral Ave., City	32	32
Porter, J. W.	5 Fontana Apts., City	152	......
Porter, T. H.	Box 38, Portage la Prairie, Man.	116	96
Pratt, R. B.	710 Elec. Ry. Chbrs. City	46	46
Pratt, G. R.	296 Lipton St., City	82	158
Quail, J.	402 Huron & Erie Bldg., City	186	......
Redmond, A. V.	Box 12, Union Sta., City	63	170
Reid, J.	484 Lipton St., City	131	180
Richardson, W. H.	Box 56, Minitonas, Man.	206	164
Ricketts, S. F.	418 Home St., City	172	......
Rimmington, H. S.	33 Riverview Apt. Balmoral Pl., City	170	156
Ritchie, N. T.	728 Furby St., City	250	200
Robinson, W. A.	259 Young St., City	111	123
Robison, E. W.	213 Ross St., Ft. William, Ont.	52	52
Roberts, T. L.	269 Linwood Ave., St. James, Man.	36	171
Robinson, G. H.	Arborg, Man.	211	161
Robinson, R. C.	P.O. Box 501, Dauphin, Man.	124	168
Rodd, B. T.	Dundee, Man.	218	187
Rocchetti, J.	9 Claydon Apts., City	19	19
Rogers, G. W.	Eng's. Office, Berry St., St. James, Man.	143	80
Ross, D. A.	710 Elec. Ry. Chbrs. City	29	29
Ruttan, J. D.	Mun. Hall, Ft. Garry P.O., Man.	121	174
Schofield, S.	14 Inglis Apts., Notre Dame Ave., City	103	74
Scholefield, F. W. B.	c-o J. McDiarmid & Co., Myrtle & Wpg. Sts., City	93	58

37

Name	Address	App. No.	Cert. No.
Schofield, J.	38 Home St., City	204	142
Scott, H. D. H.	355 Harcourt St., Sturgeon Creek	149	112
Scott, W. M.	188 Montrose St., City	15	15
Shand, H.	1 Noble Crt., City	223	184
Sharpe, D. N.	New Civic Bldg., City	175	60
Shepherd, W. R.	P.O. Box 83, Portage la Prairie, Man.	68	42
Shillinglaw, W. H.	302 Russell St., Brandon, Man.	145	149
Silcox, L. E.	Eng. Dept., C.N.R., City	232	135
Sill, A. J.	Eng. Dept., C.N.R., City	215	183
Smith, A. W.	533 Basswood Pl., City	69	134
Smith, W. N.	311 Elec. Ry. Chbrs., City	64	79
Smith, H. M.	524 Home St., City	147	......
Stainton, H. H.	1100 Paris Bldg., City	17	17
Street, L. J.	612 Notre Dame Invest. Bldg. City	28	28
Stout, C. V.	Greencourt, Alta.	242	197
Sullivan, J. G.	703 McIntyre Bldg., City	23	23
Sutherland, A. J.	1005 Garfield St., City	109	116
Sutherland, D. G.	Selkirk, Man.	201	100
Swain, R. J.	106 Victoria St., St. Boniface, Man.	141	125
Tate, N. S.	18 Muskoka Apts., 110 Young St., City	86	177
Taunton, A. J. S.	Good Rds. Board, Par. Bldgs., City	50	
Taylor, J. C. D.	604 Jubilee Ave., City	48	137
Taylor, R. E.	Ste. 21, Gordon Apts. Victor St., City	61	77
Taylor, Wm. C.	203 Elec. Ry. Chbrs., City	181	64
Turnbull, T.	808 Preston Ave., City	65	56
Turtle, A. C.	23 Evanson St., City	227	190
Umphrey, F. E.	Miami, Man.	99	92

Name	Address	App. No.	Cert. No
Veitch, J.	B3 Westmoreland Apts., Preston Ave., City	108	45
Vercoe, H. L.	196 Elm St., City	155	......
Waddell, N. M.	C.N.R., Brandon, Man.	240	192
Wakefield, J. A.	City Eng's. Office, City	120	......
Walin, H. S.	609 Elec. Ry. Chbrs., City	247	198
Walley, C. S.	107 Florence Ave., City	137	62
Wallis, N. J.	Pub. Wks. Dept., Par. Bldgs., City	105	110
Walkden, W.	75 Dufferin Ave., Norwood, City	79	155
Warrington, G. A.	277 Aubrey St., City	42	97
Weatherbee, L. B.	140 Spence St., City	188	......
Weeks, R. E.	Box 47, Souris, Man.	231	132
Welsford, H. G.	Dom. Bridge Co., City	136	119
White, H. M.	981 Grosvenor Ave., City	31	31
Wilkins, S.	Wpg. Elec. Ry. Co., City	44	44
Wilson, T. T.	Box 539, Dauphin, Man	193	139
Woodman, J.	504 River Ave., City	38	38
Wright, G. R.	Can. Gen. Elec. Co., City	165	8
Young, A. A.	505 Elec. Ry. Chbrs., City	22	22
Young, J.	201 Scotia St., City	18	18
Youngman, W.	Good Rds. Board, Par. Bldgs., City	35	114

No. 86120

Appendix 2(a)

Copy of a Report of a Committee of the Executive Council, approved by His Honour the LIEUTENANT-GOVERNOR

on 26th May 1916

On the recommendation of the Honourable the Minister of Public Works,

Committee advise,

THAT Engineers and Draughtsmen now engaged or in future to be engaged on the GOOD ROADS STAFF, shall come within the following classifications, with such salaries as are hereinafter set forth:

CHIEF ENGINEER -- To commence with a salary of TWENTY FOUR HUNDRED DOLLARS ($2400.,) per annum, and to receive an annual increase thereto of ONE HUNDRED DOLLARS ($100.00) until a maximum salary of THREE THOUSAND DOLLARS ($3,000.00) per annum is attained.

BRIDGE ENGINEER -- To Commence with a salary of EIGHTEEN HUNDRED DOLLARS ($1800.00) per annum, and to receive an annual increase thereto of ONE HUNDRED DOLLARS ($100.00) until a maximum salary of TWENTY FOUR HUNDRED DOLLARS ($2400.00) per annum is attained.

ASSISTANT BRIDGE ENGINEER -- To commence with a salary of FIFTEEN HUNDRED DOLLARS ($1500.00) per annum, and to receive an annual increase thereto of ONE HUNDRED DOLLARS ($100.00) until a maximum salary of TWO THOUSAND DOLLARS ($2,000.00) per annum is attained.

ROAD ENGINEER -- To commence with a salary of FIFTEEN HUNDRED DOLLARS ($1500.00) per annum, and to receive an annual increase thereto of ONE HUNDRED DOLLARS ($100.00) until a maximum salary of TWENTY ONE HUNDRED DOLLARS ($2,100.00) per annum is attained.

ASSISTANT ROAD ENGINEER -- To commence with a salary of TWELVE HUNDRED DOLLARS ($1200.00) per annum, and to receive an annual increase thereto of ONE HUNDRED DOLLARS ($100.00) until a maximum salary of FIFTEEN HUNDRED DOLLARS ($1500.00) per annum is attained.

CHIEF DRAUGHTSMAN -- To commence with a salary of THIRTEEN HUNDRED AND TWENTY DOLLARS ($1320.00) per annum and to receive an annual increase thereto of SIXTY DOLLARS ($60.00) until a maximum salary of SIXTEEN HUNDRED AND TWENTY DOLLARS ($1620.00) per annum is attained.

ASSISTANT DRAUGHTSMAN--To commence with a salary of NINE HUNDRED DOLLARS ($900.00) per annum, and to receive an annual increase thereto of SIXTY DOLLARS (60.00) until a maximum salary of TWELVE HUNDRED DOLLARS ($1200.00) per annum is attained.

AND THAT in pursuance of the foregoing regulations, the members of the present staff of GOOD ROADS ENGINEERS be and are hereby classified as follows, with such salary, dating from April 1st, 1916, as is shown opposite the name of each member of such staff:-

M.A. Lyons,...............	Chief Engineer	$ 2500.00
S.A. Button, ...	Road Engineer	1720.00
J.L. Cote	Road Engineer	1500.00
P.B. Gaffney	Bridge Engineer	1800.00
H. Lloyd	Asst. Bridge Engineer	1500.00

Certified
Clerk, Executive Council.

Winnipeg, Manitoba,
26th May 1916
(The Honourable Mr. Norris in the chair).

[illegible]

February 23rd 1925

GOOD ROADS ENGINEERING STAFF SHOWING SALARIES NOW BEING PAID AND CHANGES RECOMMENDED

Name	Present Salary Per Annum	Salary Recommended	Increase
	DISTRICT ENGINEERS		
Allan Findlay	$2880.00	$3120.00	$240.00
W.A. Robinson	3000.00	3120.00	120.00
W.H. Hunt	3000.00	3120.00	120.00
H.R. Urie	2640.00	3000.00	360.00
W. Youngman	3120.00	3120.00	-
J.C. Irving	2520.00	3000.00	480.00
J.H. Baldock	2640.00	3000.00	360.00
T.[illegible] Wilson	3120.00	3120.00	-
	BRIDGE ENGINEERS		
R. Lloyd	$3120.00	3120.00	-
E.W.H. James	2880.00	3120.00	240.00
E.S. Kent	3000.00	3120.00	120.00
B.A. Johnston	3000.00	3120.00	120.00
A.J. Taunton	3000.00	3120.00	120.00
	ASSISTANT ENGINEERS		
James Watson	$2400.00	2400.00	0
	OFFICE ENGINEER		
W.B. MacTaggart	$2880.00	2880.00	-
	CHIEF DRAUGHTSMAN		
George Tester	$2300.00	2400.00	100.00
	CHIEF ENGINEER		
H.A. Lyons	$36000.00	4200.00	600.00

copy.

December 22nd. 1928.

Hon. W.R. Clubb,
Minister of Public Works,
Buildings.

Dear Sir:-

The recommendation of the Deputy Minister, approved by yourself, that the following members of the Staff of the Good Roads Branch, be granted increases in salary, as indicated opposite each name, dating from July 1st. 1928, is concurred in:

NAME	POSITION	PRESENT ANNUAL SALARY	PROPOSED ANNUAL SALARY.
M.A. Lyons	Chief Engineer	$3900.00	$4200.00
T.T. Wilson	Construction Engineer	3500.00	3800.00
W. Youngman	Maintenance Engineer	3500.00	3800;00
A. Findlay	Surveyor	3120.00	3240.00
J.C. Irving	District Engineer	3120.00	3240.00
W.H. Hunt	"	3120.00	3240.00
E.C. Cowan	"	3000.00	3120.00
J.W. Baldock	"	3120.00	3240.00
H.R, Urie	"	3120.00	3240.00
H.W.R. Gemmel	"	3000.00	3120.00
J. Fourneaux	Asst. "	2400.00	2520.00
D. Smith	" "	2400.00	2520.00
R.J. McKenzie	" "	2400.00	2520.00
J. McDonald	" "	2400.00	2520.00
J. Watson	" "	2400.00	2520.00
N.B. MacTaggart	Office Engineer	3120.00	3240.00
E.W.M. James	Bridge Engineer	3120.00	3240.00
H. Lloyd	" "	3120.00	3240.00
A.H. Taunton	" "	3120.00	3240.00
B.A. Johnston	" "	3120.00	3240.00
G.G. Teeter	Chief Draughtsman	2400.00	2520.00
J.J.P. Bowler	Draughtsman	1800.00	1920.00
J.W. Allan	Cost Record Clerk	1800.00	1900.00

Yours truly,

ACTING CIVIL SERVICE COMMISSIONER.

LJH/P.

COAST TESTING LABORATORIES LIMITED

INSPECTING & TESTING ENGINEERS

TELEPHONE MARINE 3045

1009 VANCOUVER BLOCK, VANCOUVER, B.C.

Date Sept. 24, 1945

Report of Treatment and Inspection of Creosoted Douglas Fir Lumber Report No. 174

Treated by Canada Creosoting Co. Ltd., at North Vancouver

For Bridge Branch, Province of Manitoba Order No. GR 1

Reported to Mr. E.W.M. James, Bridge Engineer, Department of Public Works, Winnipeg, Man.

Charge No. 226

TOTAL CONTENTS OF RETORT

Pcs.	Dimensions	Length	Board Ft. Cubic Ft.
	12 x 12		24,123
		cubic feet	2,010
(For Fisher River Bridge)			
Total			

TREATMENT.

Time—in Bath 15 *Hrs. Under Pressure* 3 *Hrs.*
Total Time for Treatment 23 *Hrs.*
Temp. in Bath—At Start 184 *°F. At end* 190 *°F.*
Temp. under pressure—At start 190 *°F. At end* 186 *°F.*
Pressure—At start 50 *Lbs. At end* 130 *Lbs.*
Condensation in last hour of bath 1/10 lb *per cu. ft. per hr.*
Oil required per Cubic Foot 6.0 E.C. *Lbs.*
Total Weight of Oil Injected 13100 *Lbs.*
Weight of Oil Retained per cubic foot 6.02 *Lbs.*
Total Number of Gallons Retained 1395
Vacuum Maintained during bath 25
Depth of Black Oil in borings, Max. 7/8 *" Min.* 1/2 *" Ave.* 5/8 *"*

PRESERVATIVE

Sp. Gr. °C	% Tar Acid Extracted at °C	Per Cent. Water	Insoluble in Benzol	Coke Residue	Float Test at 70° C.
1.069		1.89	.45%	.9%	

(DISTILLATES PER CENT. BY WT.)

0 °C to 210 °C	210 °C to 235 °C	235 °C to 270 °C	270 °C to 315 °C	315 °C to 355 °C	355 °C Residue °C
1.22	11.6	23.15	11.4	18.4	30.4

	No. of Piles	Lineal Feet	Board Feet
Previously reported accepted			
Accepted this report			24,123
Total accepted			24,123

COAST TESTING LABORATORIES LIMITED

D.S. McDonald Inspector.

A.E. [signature]

SANFORD EVANS BUILDING NEWS SERVICE
October 5, 1935. M-792A

WINNIPEG, MAN. Separate tenders are being received by W.R. Clubb, Minister of Public Works, Wpg. until noon, Oct. 11, for the following work.
1) Constructing of substructure for bridge over Assiniboine River near Kentyre St. in St. James.
2) Fabricating and erecting steel super structure for the above bridge.
3) Grading approaches to the above bridge.
Each tender must be accompanied by a marked cheque or bid bind. Plans and specifications may be obtained at Room 315 Parliament.

SANFORD EVANS BUILDING NEWS SERVICE

October 12, 1935. M-792B

WINNIPEG, MAN. The following tenders were received by W.R. Clubb, Minister of Public Works, Winnipeg for the construction of the St. James Bridge:

Superstructure

Dominion Bridge Company,	$69,880
Manitoba Bridge & Iron Works,	73,840

Substructure

	With Con.Road	With Con.Road
Macaw &Macdonald,	62,636	52,067
Wpg. Supply&Fuel Co.	64,356	55,168
Carter Halls, Aldinger Co.	65,746	55,251
Mutual Contractors Limited,	69,175	58,903
V. Michie,	86,054	75,053

Grading Approaches

Williams Engineering Co.	$7,665

All firms of Winnipeg.
First reported Sept. 10, 1935

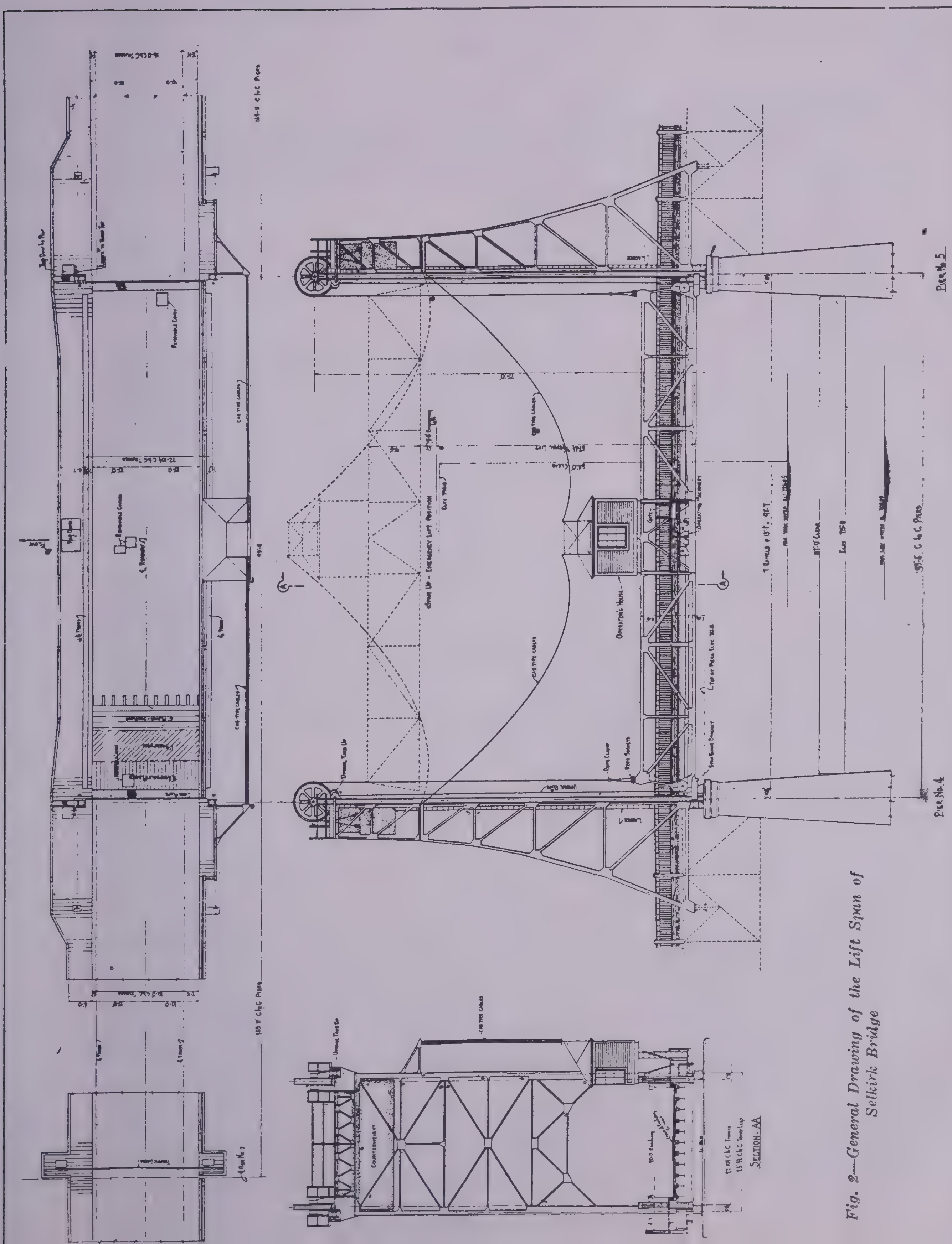


Fig. 2—General Drawing of the Lift Span of Selkirk Bridge

1962

Plan No. 3239
Brokenhead River

STRUCTURE

Precast Prestressed Reinforced Concrete Bridge having an overall length of 137'-6" and a clear roadway width of 30'-0".

LOCATION

Over Brokenhead River on South Lane of P.T.H. #4 E., N.W. 1/4 Sec. 32-12-8 E. in the R.M. of Brokenhead.

COST ANALYSIS

Prestressed Beam Contract [Supercrete]	$12,840.00
General Contract [Harper Const.]	$31,660.00
Materials	$14,964.48
Asphalt Surfacing	$1,600.00
Total	$61,064.48

Area of Roadway 4125 Sq. Ft.

Cost per Sq. Ft. of Roadway	$14.80
Cost of Substructure per sq. ft. of Roadway	$5.72
Cost of Superstructure per sq. ft. of Roadway including cost of Approach Slabs.	$8.46 not

PRECAST PRESTRESSED I BEAMS

46"x21" - 68'-0" Volume 10.53 cubic yards

Supply and Fabrication	$1,100.00;	Cost/cu. yd. $104.47
Erection	150.00	14.25
Total Cost	$1,250.00	$118.72

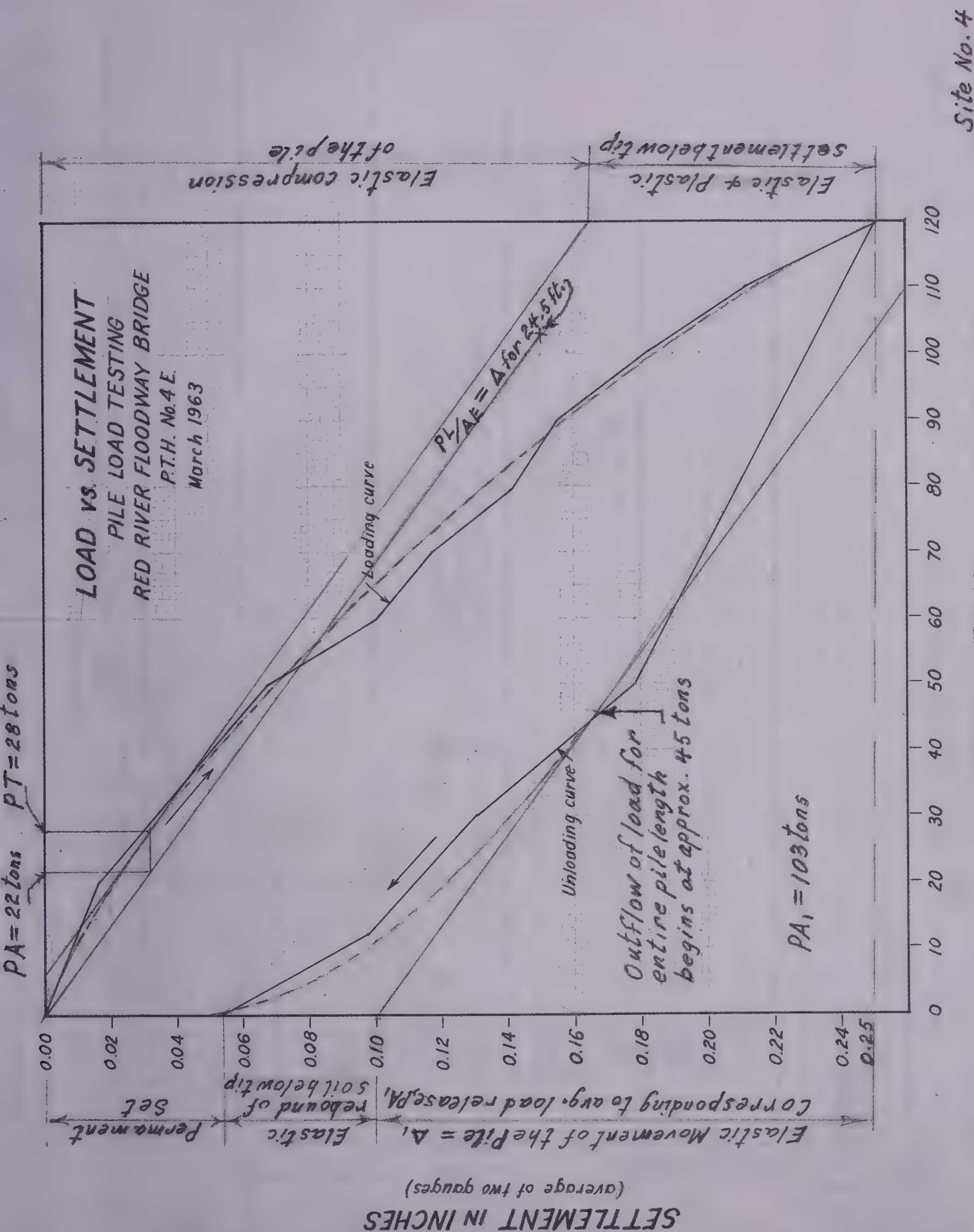

Site No. 4
LOAD vs. SETTLEMENT
PILE LOAD TESTING
RED RIVER FLOODWAY BRIDGE
P.T.H. No.4 E.
March 1963
Elastic compression of the pile
Elastic + Plastic settlement below tip
PL/AE = Δ for 24.5 ft.
Loading curve
Unloading curve
Outflow of load for entire pile length begins at approx. 45 tons
PA1 = 103 tons
PA = 22 tons
PT = 28 tons
LOAD IN TONS
SETTLEMENT IN INCHES
(average of two gauges)
Permanent Set
Elastic rebound of soil below tip
Elastic Movement of the Pile = Δ1 Corresponding to avg. load release, PA1

Figure 4.

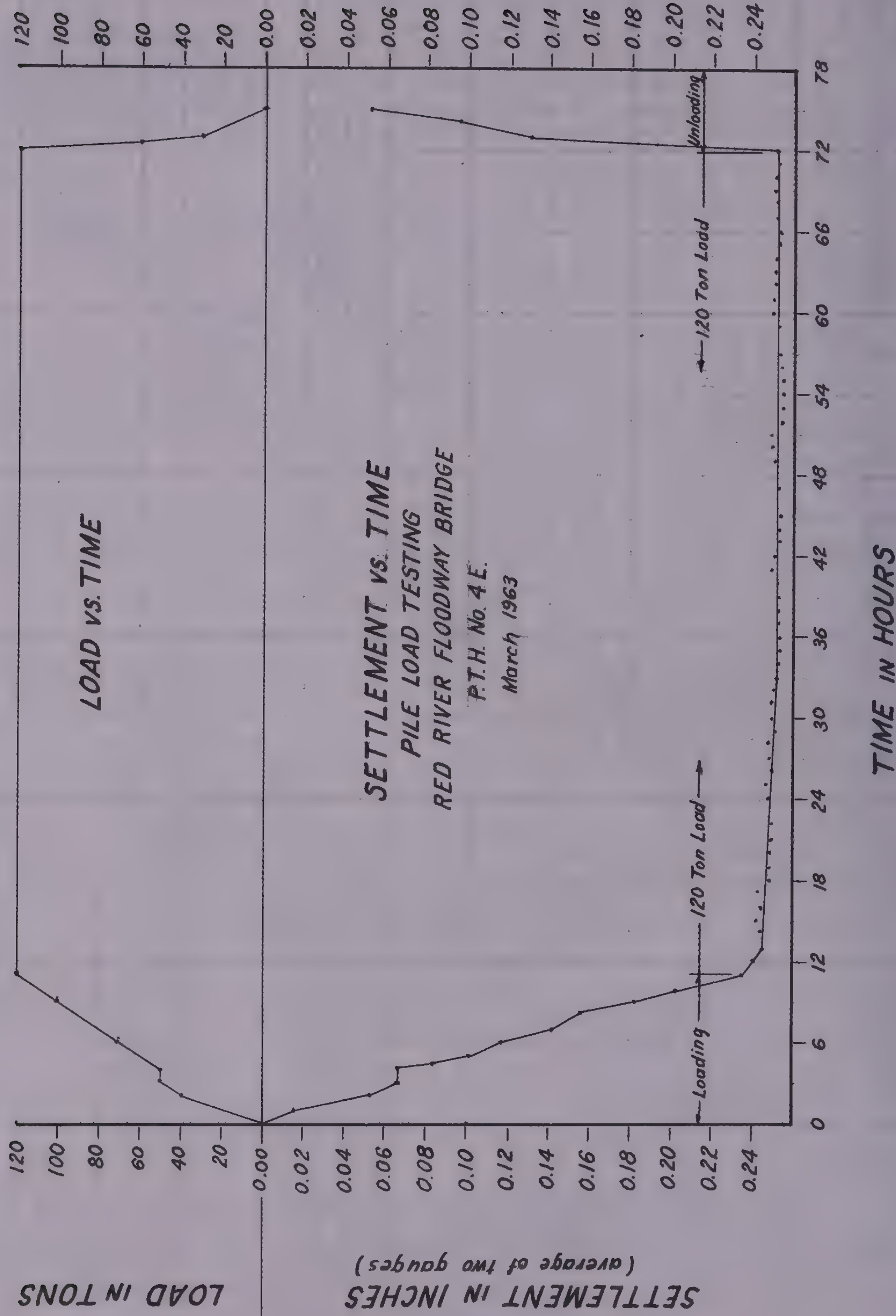

LOAD vs. TIME
SETTLEMENT vs. TIME
PILE LOAD TESTING
RED RIVER FLOODWAY BRIDGE
P.T.H. No. 4 E.
March 1963
Loading
120 Ton Load
120 Ton Load
Unloading
TIME IN HOURS
LOAD IN TONS
SETTLEMENT IN INCHES
(average of two gauges)

Figure 5.

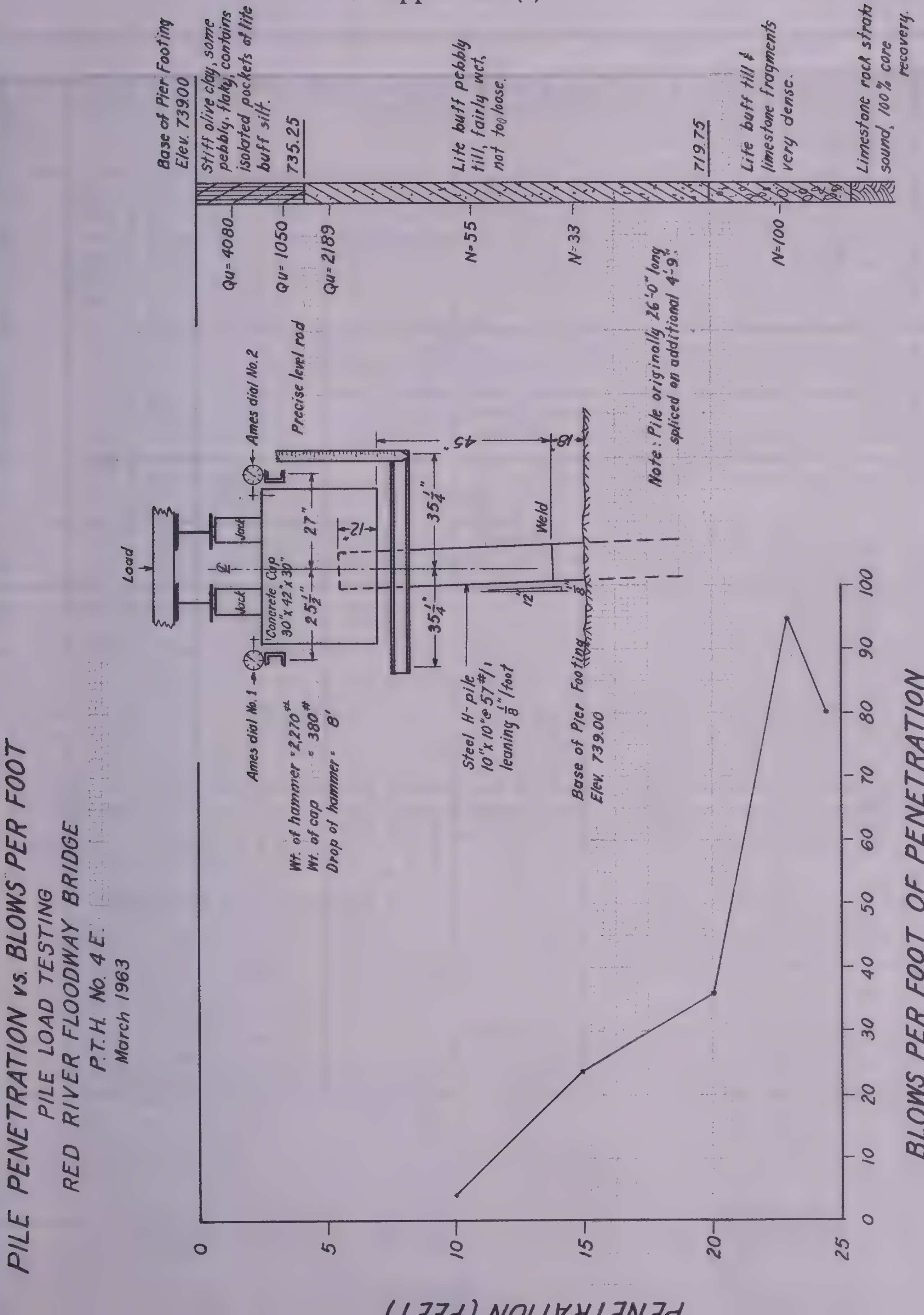

PILE PENETRATION vs. BLOWS PER FOOT
PILE LOAD TESTING
RED RIVER FLOODWAY BRIDGE
P.T.H. No. 4 E.
March 1963
Wt. of hammer = 2,270#
Wt. of cap = 380#
Drop of hammer = 8'
Ames dial No. 1
Ames dial No. 2
Load
Jack
Concrete Cap 30"x 42"x 30"
25½"
27"
35¼"
45"
18
12
Precise level rod
Weld
Steel H-pile 10"x 10"@ 57#/1 leaning ⅛"/foot
Base of Pier Footing Elev. 739.00
Note: Pile originally 26'-0" long spliced on additional 4'-9".
Qu = 4080
Qu = 1050
Qu = 2189
N = 55
N = 33
N = 100
Base of Pier Footing Elev. 739.00
Stiff olive clay, some pebbly, flaky, contains isolated pockets of lite buff silt.
735.25
Lite buff pebbly till, fairly wet, not too loose.
719.75
Lite buff till & limestone fragments very dense.
Limestone rock strata sound, 100% core recovery.
PENETRATION (FEET)
0
5
10
15
20
25
BLOWS PER FOOT OF PENETRATION
0
10
20
30
40
50
60
70
80
90
100

Figure 6.

RED RIVER FLOODWAY BRIDGE

P.T.H. No. 4 East

STEEL GIRDER ALTERNATIVE

Substructure and Deck - Poole Engineering (WCCF-12)	$134,159.00
Steel Girders - Bridge and Tank Western (WCCF-15)	$143,649.40
Miscellaneous Metals - Manitoba Bridge (WCCF-13)	15,577.00
Other Materials	46,250.60
TOTAL--	$339,636.00

CONCRETE GIRDER ALTERNATIVE

Substructure and Deck - Poole Engineering (WCCF-12)	$129,747.50
Concrete Girders - Preco Ltd. (WCCF-14)	$ 89,073.75
Misc. Metal & Structural Steel-Manitoba Br.	$ 31,720.30
Other Materials	$ 39,976.45
Total -	$290,518.00

June 1967 SPECIFICATION 1036

SPECIFICATIONS FOR CONCRETE TOPPING ON NEW SURFACES

1036. 1. GENERAL CLAUSES

The General Specifications hereto attached shall apply to and be a part of these Specifications.

1036. 3. DESCRIPTION

This work shall consist of mixing and placing concrete in accordance with "Specifications for Reinforced Concrete," hereto attached, screeding and finishing concrete in accordance with the "Specification for Reinforced Concrete Deck Slabs, Approach Slabs End Newel Posts, Curbs, Sidewalks and Medians," hereto attached, sandblasting existing surfaces, applying epoxy resin, placing reinforcing mesh and wet curing concrete.

1036. 5. MATERIAL SUPPLY

Material Supply shall be as per Sections 5.1 and 5.2 of the "Specifications for Reinforced Concrete" and section 5 of the "Specifications for Reinforced Concrete Deck Slabs, Approach Slabs, End Newel Posts, Curbs, Sidewalks and Medians" hereto attached with the Exception of:-

a) The coarse aggregate shall conform to the following gradation:

Passing	½"	screen	100% -
"	3/8"	"	80% - 85%
"	No. 4	"	0% - 5%
"	No. 200	"	0% - 1%

b) The Minister will supply Epoxy Resin at the source of supply as specified in the Special Provisions.

1036. 9. CONSTRUCTION METHODS

9.1 Thickness of Topping

The minimum thickness of the topping shall be as shown on the plans. The actual thickness shall be as set from the screed heights provided by the Engineer.

9.2 Preparation of Surface

The surfaces over which the concrete toppings are to be applied shall be thoroughly sandblasted to remove all laitance and dirt prior to the application of Epoxy Resin and placing of concrete. The sandblasting operations shall be done after all preparatory work such as grouting of keys is completed.

The time interval between the sandblasting and placing of the concrete topping shall be kept to a minimum and extreme care shall be taken to keep the sandblasted surfaces clean during that time. All residue and dirt after sandblasting shall be removed from the top of the bridge.

Sandblasting will be considered incidental to concrete topping and no separate measurement will be made of this work.

1036. 9. CONSTRUCTION METHODS (cont.)

9.3 Application of Epoxy Resin

The epoxy resin shall be mixed as per manufacturers instructions in shallow and wide containers to provide as much surface area as possible during the mixing operations. The mixing shall be done in a cool area, and artificial cooling shall be provided if required to increase the set time of the epoxy.

Only sufficient epoxy shall be mixed at any one time as required for the concrete placing operations. Any epoxy wasted due to contractors mixing more than required at any one time shall be replaced at the contractors own expense.

The epoxy shall be applied to the existing surfaces by means of a stiff bristle brush as soon as it is mixed and only in such quantity so as to keep the time between the application of epoxy and placing of concrete to an absolute minimum. The rate of application will be approximately 100 square feet per gallon.

9.4 Mixing of Concrete

The concrete for concrete topping shall be mixed at the site and shall have a slump of 1 to 2 inches.

9.5 Placing of Reinforcing Mesh

After the concrete has been placed to within 1" of the top surface the contractor will be required to place the reinforcing mesh. The remainder of concrete may then be placed and finished. The reinforcing mesh will be supplied in rolls and shall be cut by the contractor to convenient size as approved by the Engineer. The individual reinforcing mesh mats shall overlap by a minimum of one reinforcing mesh square. The placing of reinforcing mesh will be considered incidental to concrete topping and no separate measurement will be made for this work.

9.6 Weather Conditions

When the concrete topping is placed during hot summer days the work shall be so arranged that the placing and finishing operations are completed by 11:00 A.M..

Cold weather precautions if required shall be in accordance with the specifications for "Enclosing and Heating" other than the temperature during placing shall be kept between 50 and 60 degrees Fahrenheit.

The Association of Professional Engineers of the Province of Manitoba

The following rules are a general guide to conduct and are not intended to deny the existence of other duties equally important though not specifically mentioned.

The Council is empowered to enforce the rules herein established, but it is the privilege of any member to consult the Council as to the proper conduct to pursue in any specific case.

Code of Ethics

To the State

1. The Professional Engineer owes a duty to the State, to maintain its integrity and its law, and not to aid, counsel or assist any person to act in any way contrary to its laws.

2. When engaged as an expert witness he shall at all times act with candor and fairness, and give, to the best of his knowledge and ability, an honest opinion based on adequate study of the matter in hand.

To His Client

3. He shall act in all professional matters strictly in a fiduciary manner with regard to any clients whom he may advise and his charges to such clients shall constitute his only remuneration in connection with such work, except as provided by Clause 6.

4. He shall not accept any trade commissions, discounts, or allowances under any circumstances, nor any indirect profit, except as provided by Clauses 5 and 6, in connection with any work which he is engaged to design or superintend or with professional business which may be entrusted to him.

5. He shall not, while acting in a professional capacity, be at the same time, without disclosing the fact in writing to his Clients, a Director or Member, or a Shareholder in, or act as Agent for, any contracting or manufacturing Company or firm or business with which he may have occasion to deal on behalf of his Clients, or have any financial interest in such a business.

6. He shall not receive, directly or indirectly, any royalty, gratuity or commission, on any patented or protected article or process used on work which he is carrying out for his Clients, without first disclosing the fact in writing to his Clients.

7. He shall not improperly solicit professional work, either directly or by an agent, nor shall he pay, by commission, or otherwise, any person who may introduce Clients to him.

8. He shall not be the medium of payments made on his Clients' behalf to any Contractor or business firm (unless specially so requested by his Clients), but shall only issue certificates or recommendations for payment by his Clients.

To His Fellow Engineer

9. He shall not attempt to injure, directly or indirectly, the reputation, prospects or business of a fellow Engineer.

10. He shall not accept employment by a Client while a claim for compensation or damages, or both, of a fellow Engineer previously employed by the same Client and whose employment has been terminated, remains unsatisfied, or until such claim has been referred to arbitration, or issue has been joined at law, or unless the Engineer previously employed has neglected to press his claim, except in special cases where authority has been obtained from the Council to accept such employment.

11. He shall not attempt to supplant a fellow Engineer after definite steps have been taken towards the employment of said Engineer.

12. He shall not compete with a fellow Engineer for employment on the basis of professional charges, by reducing his usual charges and attempting to underbid after being informed of the charges named by his competitor.

13. He shall not accept any engagement to review the work of a fellow Engineer, for the same Client, without notifying such Engineer in writing, or unless the connection of such Engineer with the work has been terminated.

14. In general the Engineer should think highly of his profession, its history and traditions, and should ever act in a manner worthy of its honor and dignity.

15. A breach of any of the foregoing Rules of Conduct by any member of this Association shall be considered inconsistent with honorable and dignified deportment in his professional practice, and such a member may be deemed guilty of unprofessional conduct, and thereby subject to discipline under Section 19, sub-section 1, of the Engineering Profession Act.

Adopted November 1st, 1921.

Bibliography

Hydrology

1. Harden, Neil -"Frequency Curves". Hydrotechnical Services Branch, Department of Natural Resources, Province of Manitoba, 1989-1991.

2. Meid, P.O.; Schoenfeld, D.A., - "The determination of gross and effective drainage areas in the Prairie Provinces", Addendum No. 4 to Hydrology Report #104, Hydrology Division, Agriculture Canada Prairie Farm Rehabilitation Administrative Service, Regina, Saskatchewan. January, 1989.

Newspaper

Winnipeg Tribune, "FIRST OF ALL AN ENGINEER" LYONS RETIRES FROM PUBLIC WORKS POST, May 3, 1946, p. 15, col. 3 & 4.

Pile Load Tests

1. De Pauw, G. A., Saltzberg, W. - "Load Test on 10"x10" @ 57 lb/ft Steel H-Pile" for Water Control and Conservation Branch, Department of Agriculture and Bridge Engineer's Office, Department of Public Works, Province of Manitoba, April, 1963.

2. De Pauw, G. A., Schultz, G. - "Pile Test Report on Treated Timber Pile at First Street Bridge at Brandon, Bridge Office Plan No. 2582". January, 1972.

3. Lautens, L. F., Donachuk, S. L., - "Report on Static Pile Load Test Conducted on a Single 356 mm (14") HEX. Precast Prestressed Concrete Pile". Bridge Site No. 4454, Twin Grade Separation Structures, T.C.H. 1 East and Relocated P.T.H. No. 12, In Fractional Sec. 36-8-6 E., R. M. of Ste. Anne, April 16, 1982.

4. Sapinski, S., Schultz, G. -"Analysis of Pile Loading Tests on a Single Treated Timber Pile embedded in Glacial Lake Agassiz Clay". A paper for the 1969 Conference of the Western Association of Canadian Highway Officials. Province of Manitoba, Highways Department, Bridge Division. August 25, 1967.

Technical Publications

1. Cudney, Gene R. "Stress Histories of Highway Bridges" American Society of Civil Engineers Structural Journal, Vol. 94, ST.12, December 1968, p. 2725.

2. Waddell, J.A.L. "Bridge Engineering", John Wiley and Sons Inc., Vol. II, Chapter LIII, (True Economy in Design), 1916.

Notes

1. "P. Eng." is the common abbreviation used for "Professional Engineer", which can only be legally appended behind a person's name if he/she is registered with one of the Provincial Associations of Professional Engineers in Canada. The Engineering Profession Act reads as follows:

   Practice restricted.
   14(1) No person who is not a member or a licensee shall engage in the practice of professional engineering within the province or take or use the title "professional engineer" or "ingenieur" or any abbreviation thereof. (1985 edition, p. 5)

2. The quotation was taken from Mr. M.A. Lyons' application for registration with the Association of Professional Engineers for the Province of Manitoba, dated September 25, 1920, describing his qualifications and experience.

3. The records in the office of the Bridge Division of the Department of Highways and Transportation are now identified by "Site No." which is synonymous with the "Plan No." found on the drawings in the title box. This is the only number assigned to any specific pin-point location on a set of maps of the Municipalities, kept updated in the office. Under this number, a person can locate all the information pertaining to any bridge that was ever built at that site, such as survey plans, subsoil investigation reports, laboratory soil sample test results, design notes, correspondence, drawings, contract documents, inspection reports and construction records.

Subject Index

E.

F.

G.

H.

I.

L.

M.

N.

P.

R.

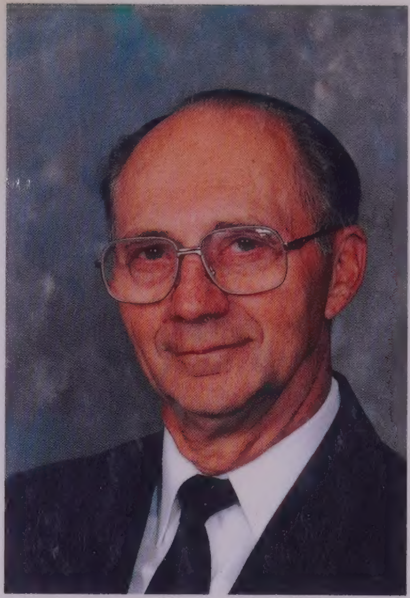
S.

T.

U.

W.

Z.



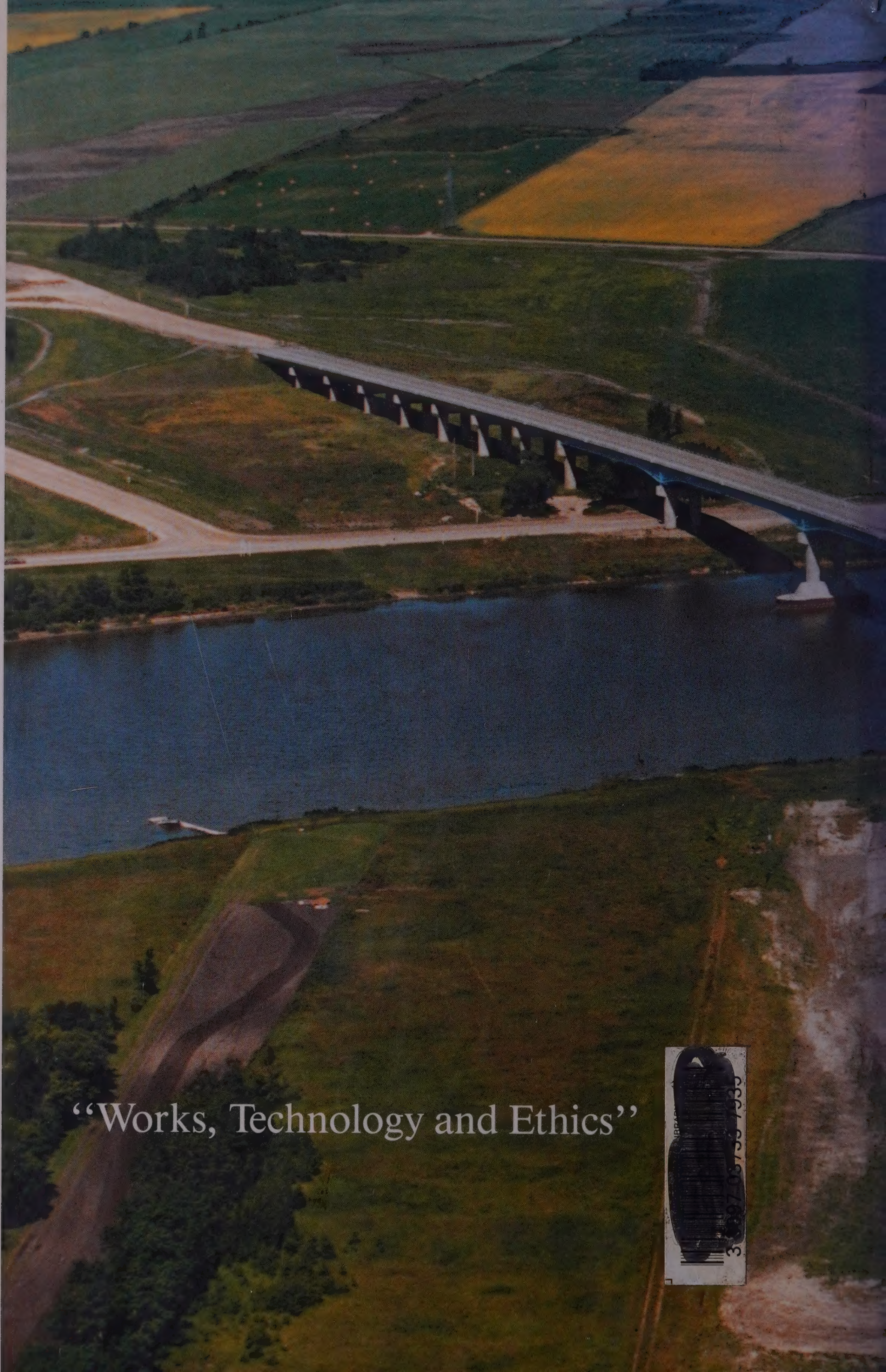
The Author

George Alois De Pauw, P. Eng., was born on April 1, 1926, at St. Alphonse, Manitoba. The hamlet, nestled in the hills along the beautiful Cypress River valley, is located 100 miles (161 km) south-west of Winnipeg. It was home to many of the Belgian immigrants, mostly of Flemish origin, who came to Manitoba after the first world war.

The author obtained his B. Sc. Degree in Civil Engineering from the University of Manitoba in May, 1948 and after graduation joined the Department of Highways and Public Works, for the Province of Manitoba to work as a resident highway engineer. In 1951 he was transferred to the bridge design office and was promoted to the position of Chief Bridge Engineer in 1957; retiring as the Director of Bridges and Structures in May, 1988, after forty years of dedicated service.

He became registered with the Association of Professional Engineers of the Province of Manitoba on May 20, 1954; was President in 1974, a member of council from 1972-75, and 1985-86 and served on many committees in support of the practising design engineer; receiving the "Outstanding Service Award" from his Association on October 19, 1987.

Having briefly worked for Mr. E. W. James, the "Grand-Father of Bridge Design for the Province", in 1951, the author is well qualified to write the story about "Pioneering in Highway Bridges for the Province of Manitoba and the Engineering Profession".



"Works, Technology and Ethics"